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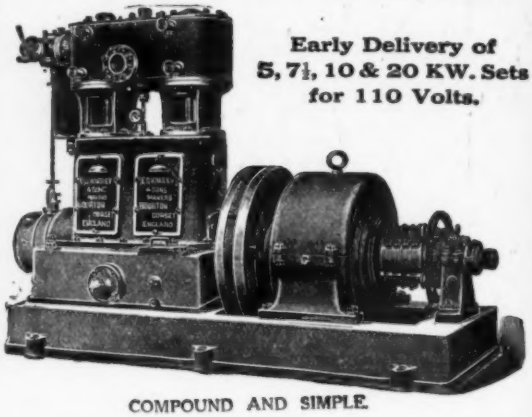

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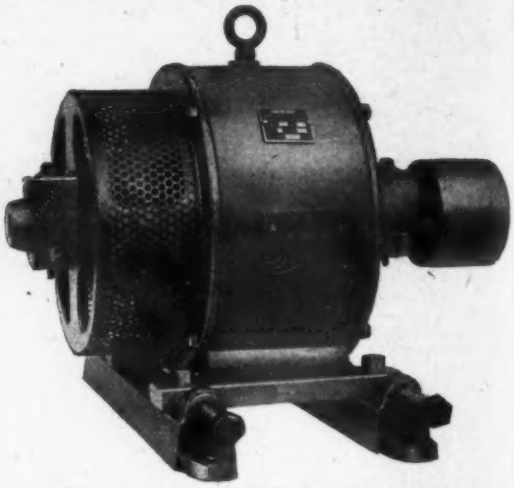

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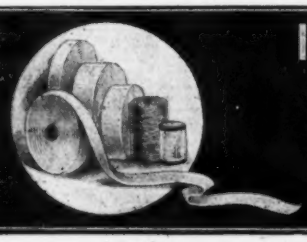

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ELECTRICAL REVIEW.

VOL. LXXXIX. DECEMBER 9, 1921. No. 2,298.

ELECTRICAL REVIEW.

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THE UNEMPLOYED PROBLEM.

IT is a matter for deep concern that with the Christmas season so near at hand, and with winter approaching, there are so few indications of any increase of employment. Indeed, the last figures circulated show an actual increase of unemployment for the week ended November 18th, the number of unemployed persons growing from 1,789,432 to 1,817,000. But it does not do to judge the situation merely by weekly comparisons or by statistics only. If we go back to June in our reckoning we find that the unemployed persons numbered 2,177,899. Many influences are at work making for trade revival and more employment due to other causes, and we shall not be surprised if the situation improves considerably within the next six months. The improvement between now and the spring-time is likely to be slow, but it should be sure now that factors making for reduced cost of production and of building and the general cost of living are coming more effectively into play. The present terribly heavy burdens of taxation, both personal and industrial, are a serious restriction on enterprise, and any hints from high quarters that these may be lessened at the end of the financial year kindle hopes that new enterprises now impossible will become worth while. The present indications of falls in cost of transportation, general travel, the cost of coal, and even the price of the Christmas turkey, are all to the good in making for hopefulness. But while according to a German motto "Hope is the poor man's bread," hope will not keep industry alive and provide employment wherewith a man may *purchase*, through the sweat of his brow, substantial bread, rather than depend upon national unemployment allowances.

It is worse than useless to imagine that the Government alone can put an end to unemployment by providing work for all, and that it is its duty to meet the need for work by supplying money for maintenance to anyone who cares to ask for it from the boundless resources which the Government is supposed to have at command. That "the Government" as such has any money or financial resources is, of course, known by reasonable people to be untrue. The State has nothing except that which can be extracted from the pockets of the taxpayer. Again, to continually suggest that the Government must find work is mischievous in the extreme, as leading to the belief that some kind of relief work, engineered and managed by Government officials, is the only palliative for unemployment.

Having said this much, we are fain to confess that it is not easy to suggest, much less to provide, a remedy. We conceive, however, that in order to get into the proper frame of mind to consider a remedy it is best to look at some of the causes of the disease, and see whether any of those causes can be removed. We do not propose to enumerate them all; but there are three of outstanding importance. First, the Great War and all its sequelæ; second, the fact that the trade unions continue to insist on their demands for short time and high wages; and third, the artificial

maintenance of wages through the medium of Trade Boards. The war, of course, is the chief of these. It paralysed trade for a number of years, ruined many of our foreign customers, taught people abroad to do without our goods or make them for themselves, and last, but not least, it gave an impulse to foreign competition. We believe that the British taxpayer has been, and still is, ready and willing to bear his fair share of the burden of providing for the unemployed in so far as the present position was brought about by the war; but he is entitled to demand that organised labour and the workers themselves shall do their share. If, therefore, the Government has recourse to the payment of further doles, or to the establishment of relief works in order to tide over the present difficulty, the trade unions should consent to relax their rules, and the workers should agree to the suspension of those regulations which now compel employers to pay a minimum wage. It is not easy to see how the trade unions can be compelled to relax their rules. They did this, to their credit be it remembered, during the war, under the stress of a great national emergency. But they do not seem to realise that the effects of the war are still severely felt, and that, so long as wages are maintained at too high a level, and the worker is encouraged to refuse to do a full day's work at a reasonable wage, it is impossible for the country to recover its trade. In our view, however, something *can* be done by Government to compensate the taxpayer for the burdens which will have to be imposed upon him if further moneys are to be extracted from him. The rules which restrict hours of labour and impose minimum wages must be relaxed in order to make it possible for employers to carry on business at a profit. For it is time that those who make such rules came to realise the position of a man who, whatever else may happen, is called upon to find, at the end of each week, a large sum in ready cash to hand over to his workpeople.

Reports of the cases which are heard from time to time by Courts of Referees make it plain that there are two causes at work to promote unemployment. The first of these is the minimum wage; the second, the eight-hour day and the disinclination of the trade unions to allow overtime. As regards the minimum wage, it operates thus: An employer who is unable to pay it is on the horns of a dilemma. If he dismisses his workmen and closes his works he throws people out of work. If he pays less than the minimum, even by agreement with his workpeople, he is liable to be heavily fined, and the Ministry of Labour justifies its action in insisting on observance of the law by saying: "If one employer disregards the minimum wage, it is unfair to others who conform to it." It is all very well to prescribe a minimum wage if it be certain that the conditions prevailing at the time when the wage is fixed will continue; but events of recent months have shown that what was a reasonable minimum a short time ago has now, in many industries, become wholly unreasonable. But the minimum operates in another way. It tends to make the employer dismiss the adult and employ the child in his place. Moreover, the fact that he will have to pay more when the "child" passes the age of 18 leads to the dismissal of a number of persons who are nearing that age.

With regard to restriction of hours, a frequent cause of discharge is that a man will not work overtime either with or without payment for time worked in excess of the maximum, whatever it is. Cases from the Courts of Referees show that a worker will sometimes refuse on his own initiative; but he is more often urged to this course by his trade union, whose officials adopt the mistaken view that the less overtime is worked the more employment there will be for new hands. It is to be borne in mind, too, that all these rules as to minimum wage and restricted hours are at the present time being directly enforced by the Government in this way: that if a man is offered work at wages below the minimum rate he is justified in refusing it, and can claim unemployment benefit. Similarly, if a man is dismissed because he will not work more than the statutory number of hours, he loses his job through no fault of his own, and is entitled to sign on at the Labour Exchange and draw 15s. a week for doing nothing.

In answer to the suggestion that these restrictive rules should be modified or repealed it will, of course, be argued that they were imposed to prevent sweating and other evils; but those are ills of a bygone age which have long disappeared. It will be said, too, that to remove restriction is to compel men to work for less than a living wage; but we venture to think that there are thousands of genuine unemployed who would rather work for a small sum than be kept from starvation by a mere dole which they can have for nothing, and which they attend to receive cheek by jowl with wasters who have never worked and never mean to work.

Industrial Welfare.

We believe that there is at the present time a certain amount of impatience with welfare work, and it is manifested both by employers and by workers. It always happens that, when a movement is started amidst almost universal approval and popularity, there is some reaction after the first few years. This reaction is generally due to the natural feeling of disappointment that more has not been accomplished than can be shown. There is a feeling at first that faith should move mountains bodily; but it is at least open to question whether the first and most noticeable effect of a lively faith ought not to be a quickening of the spirit of work towards the end desired. The faith is, that *by work* certain results can be accomplished.

The first few years of any project are the most difficult. It is not very long since industrial welfare began to assume its rightful place as a laudable and worthy object in commercial business. The Industrial Welfare Society held its third annual general meeting on November 3rd, 1921, with H.R.H. the Duke of York presiding. He expressed a good deal more than a merely conventional and polite interest in the work, and afforded one more proof, if that were needed, that in the present King and his house we have a family of workers who have the true interests of all classes of the nation at heart, and who seek to advance them by every means in their power.

The Treasurer of the Society, Sir Charles Wakefield, a former Lord Mayor of London, referred to our domestic industrial troubles, which are, he said, of a more permanent nature than the transient post-war difficulties which, for the time, complicate them. Their permanence constitutes a feature which makes the "patient policy of permeation and persistent propaganda" (as Sir Charles, with a highly successful attempt at explosive alliteration, puts it) of such unique importance.

Lord Invernairn, whom our readers may more easily recall as Sir William Beardmore, thought the Society might well be more aggressive and less apologetic. That is very likely. There are other societies which would do well to bear this counsel in mind. No good ever came, as we said a few weeks ago, from hiding one's light under a bushel. However, that is by the way. Lord Invernairn hopes that there will shortly be held a large meeting of employers to consider the possibilities of the welfare movement in industry, and that the Duke of York will also preside over that meeting.

It is by patient effort on the part of employers, staff, and manual workers, each endeavouring to see and appreciate the others' points of view, that progress will be made. Each must push with his available strength, however small, in the right direction, and the movement that will result will be cumulative. Impatience will not help. It is of no use to discontinue your efforts, or to neglect the payment of your subscription because the benefits to be obtained appear to lie in the rather distant future. They may be rather nearer than they seem, and those will participate in them who have shown their worthiness by continuing their efforts in spite of discouragement.

TESTS ON INSULATING VARNISH.

By W. S. FLIGHT, A.M.I.E.E.

Introduction.

Paints and varnishes have been employed for various purposes in many industries for hundreds of years. In course of time it was found out, largely by the method of trial and error, which particular mixture of gums, oils, &c., produced the best result in each particular case. A perusal of the catalogues of any large paint and varnish manufacturer will show how many different classes of varnish are still manufactured for the different industries which he supplies. Even for the electrical industry, varnish manufacturers do not appear to be contented unless they can list from 12 to 20 different varieties. Although these are almost always accompanied by a description of their properties and uses, the would-be purchaser is often unable to decide which varnish is really the best for his particular purpose. As the selection of insulating varnish demands a knowledge of the functions which it is to perform, as well as the properties of the varnish itself, the electrical engineer is often in a far better position to make the choice than the varnish manufacturer.

To ascertain the true properties of the varnish, tests are necessary, and these can almost always be carried out on a laboratory scale with a small sample of the varnish. As very little has been published on the subject of testing insulating varnishes it is hoped that the following results will be of interest and use to many.

Insulating varnishes required by the electrical industry may be roughly divided into the following classes:—

1. *Baking Oil Varnishes.*—These require drying for three to eight hours at a temperature of about 95 deg. C. (203 deg. F.). They have, as a rule, a very high dielectric strength, great flexibility, and do not become brittle by prolonged heating at high temperatures.

On account of their high dielectric strength and good ageing properties, these varnishes are very largely employed in the manufacture of all classes of electrical machinery.

2. *Air Drying Oil Varnishes.*—These are similar to No. 1, but are specially prepared to hasten their drying properties, so that baking is not necessary. They usually require about twenty-four hours to become perfectly dry in ordinary atmospheric conditions. They have not as good ageing properties as No. 1, and consequently should only be used when it is impracticable to bake the material. This often occurs in connection with repair work, and on large apparatus which, on account of its weight, cannot be conveniently baked. These varnishes are also extremely useful on moulded insulation, &c., which would soften if subjected to the baking process required for the baking oil varnishes.

3. *Air Drying Spirit Varnishes.*—These usually consist almost entirely of gums dissolved in methylated spirits, and will air-dry in two or four hours under ordinary conditions. They are more brittle than either No. 1 or No. 2, and should only be used on stationary parts of electrical machinery, and on apparatus which is not subject to extreme variance in temperature.

Tests for Insulating Varnishes.

Although the properties of the above three classes of insulating varnishes are in many respects very different, the same tests may often be used for each type so long as the results obtained are interpreted in relation to the functions which the varnish is required to perform.

Some of the tests about to be described are only required when a very thorough investigation is to be carried out, or when some special property of the varnish is to be ascertained.

1. *Drying.*—For this and other tests different experimenters have employed different materials on which to place the varnish. Copper foil, cotton cloth and various papers have been often used in this connection, but as the object of the tests is to ascertain the properties of the varnish it is very desirable that the films of the varnish should form the greater part of the materials being tested. It is also desirable that the varnish should be tested on fibrous materials, as it is on these materials that it will be used in practice. For these reasons 0.001 in. Japanese paper has been found to be a very suitable material when used in this connection.

When the varnish is supplied by the varnish manufacturer it is usually thicker than is required by the electrical industry, and in order that its viscosity may be reduced to a good working value the neat varnish should be thinned down by the addition of a thinner recommended by the varnish manufacturer.

When the varnish has been thinned to the required viscosity pieces of jap. paper about 4 in. square are dipped into it, hung up in the air and allowed to dry. They should be so placed that they are free from draught, but should not be boxed in as an abundant supply of air is necessary to oxidise the varnish, and so convert it from a liquid to a solid state. If it is known that the varnish is an air drying one, the sample should be examined every half-hour, and the time recorded when the varnish about the centre of the paper becomes dry to the touch. If the varnish is a baking one there is little object in carrying out the test in air, except that it is easier to examine the samples than when they are placed in an oven. With baking varnish, however, a test should always be made in an oven and the samples removed at the end of each hour, cooled to air temperature and examined, until dry to the touch. The temperature of the oven for these tests should, of course, be as near as possible to that of the ovens in which the electrical apparatus is to be baked. If comparative tests only are required, a temperature of 80 deg. C. has been found to be the most convenient for laboratory investigation.

2. *Ageing Test.*—Pieces of jap. paper should be treated as for test No. 1, dried for the length of time found necessary by that test, and then given a second coating of varnish, draining the pieces in the opposite direction to the first. After drying the second coat of varnish the paper should be suspended in an oven maintained at a temperature of 80 deg. C. to 90 deg. C. It is most essential that this oven, and also the oven employed for ascertaining the time of drying, should be so constructed that a slow but continuous flow of air may pass through it. A metal oven containing a number of $\frac{1}{8}$-in. holes, evenly distributed over the top and bottom, and having electrical heating units placed in the bottom, has been found satisfactory for carrying out these tests.

From the time required for the varnish to dry it can be predicted whether the ageing is likely to be a matter of hours or of days. If the former, the samples should be examined every hour, but if the latter, daily examination will be sufficient. For the purpose of this examination the samples are removed from the oven, cooled to air temperature, and then bent over through 180 deg., so that the paper is flat on itself. At first the bending will have no effect whatever on the samples, but in course of time the varnish will become so brittle that when the paper is doubled over and pressed together it will break in two pieces. When this occurs the varnish is said to be "aged," and the extra time of heating beyond the time required for drying is taken as the time to age. In order that the paper shall never be bent twice in the same position, a small piece should

be cut from the sample and the bending test performed on that rather than on the main sample.

3. *Dielectric Strength.*—As the dielectric strength of all insulating materials depends largely on the thickness of the material, pieces of the 0.001-in. jap. paper should be cut, dipped in varnish, dried, and re-dipped a number of times until the total thickness is increased to 0.005 in. The pieces should always be drained in the opposite direction to that in which they were drained after the previous dipping; this will then produce a uniform film of varnish on both sides of the paper. Although the dielectric strength of freshly dried varnish is of importance, it is even more important to know the dielectric strength of the varnish after it has been subjected to extra heating such as it will experience in an electrical machine. Two batches of papers should, therefore, be treated for the dielectric strength tests, one batch being tested immediately after drying and the other after heating the paper at 80 deg. C. for about half the time of ageing of the particular varnish.

The dielectric strength test is usually carried out by laying the varnished paper on a flat sheet of brass, and using a piece of brass about 1 in. in diameter as the top electrode. About 1,000 volts should be applied and maintained for one minute and then increased to 2,000 volts, which again should be increased at the rate of 1,000 volts maintained for one minute until breakdown occurs. In order that reliable figures for dielectric strength may be obtained, at least five, and preferably ten, breakdowns should be obtained on both the dried and the partly-aged papers.

4. *Acidity.*—The oils and gums used in the manufacture of insulating varnishes are liable to contain organic acids, some of which readily attack copper, although they do not appear to have as destructive an action on fibrous materials. It is difficult, and of no practical value, to ascertain the acidity of liquid varnish, and it has been found most convenient to determine the acidity on the pieces of jap. paper after the above tests have been carried out. During the ageing test the varnish is continually taking up oxygen from the air, and consequently its chemical composition is changed. This often results in a decrease in the acidity, and for this reason it is usual to conduct acidity tests on both the freshly-dried and on the aged papers.

The acidity test is carried out by cutting a known weight of the varnished papers into pieces about $\frac{1}{8}$ in. square, and boiling these for four or five hours with water or methylated spirit. (If the latter is used a blank titration has to be made to allow for the acid in this spirit.) The percentage organic and inorganic acids are determined by titrating with a standard alkali, employing the usual indicators for the organic and inorganic acids.

5. *Oil-resisting Properties.*—If the varnish is intended for use on oil-immersed apparatus, it is of the utmost importance that the varnish should be capable of withstanding the action of hot insulating oil. The resistance of the varnish to hot oil depends on (*a*) the ingredients from which the varnish is made, and (*b*) the extent to which the varnish has been oxidised. Most of the baking linseed oil varnishes will withstand hot oil provided they are thoroughly dried before being immersed in the oil. On the other hand, even the best oil-resisting varnishes will give bad results on the oil tests if the varnish is not thoroughly dried before the samples are immersed in the oil. For the purpose of this test, the most reliable results are produced by winding a small coil (say, about 2 in. cube) and dipping in varnish while hot. After being thoroughly dried the coils are immersed in insulating oil and maintained at a temperature of 80 deg. C. for 100 hours. While still immersed in the oil they should be removed from the oven, cooled to air temperature, and the oil and coil carefully examined. If the varnish has satisfactory oil-resisting properties, the oil should still be clear and the coil free from any deposit or roughness. In certain cases it has been found that, due to chemical action between the oil and the varnish, the coil has become covered with a thick film of deposit, almost like a bacteria growth, which in places may be as much as $\frac{1}{4}$ in. thick. It is essential for this test that non-sludging transformer oil should be employed, and even with these oils the heating will produce darkening in colour. In order that there may be no doubt as to whether any deposit or darkening in colour is due to the oil or to the varnish, a blank test should be run consisting of oil only, without the addition of any coil or insulation. The results can then be judged with reference to this control.

6. *Sticking Qualities.*—The insulating varnish is often relied upon to cement the wires and insulating material together. This property of the varnish can be ascertained by winding a small coil as for the oil-resisting test and dipping it, after thorough drying, into the varnish. After baking for the required period, the coils should be cooled to air temperature and then cut in half with a hacksaw. If the sticking qualities are good the cutting can be done without seriously deforming the coil, and, after the coil is sawn in half, the adhesion between the various layers and turns can be readily ascertained. The test also enables the extent of the penetration, and also the internal drying properties, to be determined.

7. *Softening Temperature.*—Varnishes which are required for use on armatures and other rotating parts must not soften at the operating temperature of the machine or they will be liable to be thrown from the winding during service. When it is required to ascertain if the varnish will be satisfactory in this respect, a piece of copper weighing about 1 lb. should be coated with the varnish, dried for the required time and then placed in a 100-deg. C. oven for half an hour. It should then be removed and examined with a knife blade to see if the varnish is soft and tacky or still firm and hard.

8. *Thermal Conductivity.*—Another of the functions of insulating varnish is to assist in the transmission of heat from the inside to the outside of the coil. For this test a coil should be wound as for test No. 5, and dipped in the varnish after being thoroughly dried, and the varnish dried as usual. During the time the varnish is drying, an unvarnished coil should also be placed in the same oven so as to drive off any moisture it contains. As soon as the coils have been cooled to air-temperature after this drying, they should be connected in series and a current passed through them of such a value as to raise their surface temperature to approximately 80 deg. C. When a steady temperature has been reached the ohmic resistance of each coil should be obtained, from which the temperature rise can be calculated.

Results Obtained.

In order that the suitability of the varnish for any particular purpose may be determined from the above tests, a number of results are given below, which will enable other results obtained in like manner to be more easily interpreted.

1. *Drying.*—Air-drying linseed oil varnish, when tested in the manner described, usually takes from 12 to 24 hours to become dry to the touch. Spirit varnishes are dry as soon as their volatile solvent has been evaporated, which usually takes from one to three hours.

Baking oil varnishes require from three to six hours heating at 80 deg. C. for the jap. paper to become dry to the touch.

2. *Ageing.*—Baking oil varnish should not age in less than 100 hours. The results of a number of tests on varnishes of this description are given in Table I.

Air-drying oil varnish should not age in less than 40 hours.

Spirit varnishes are often brittle as soon as they are dry, and no satisfactory ageing tests can be carried out on varnishes of this type.

3. *Dielectric Strength.*—Table II shows a large number of results obtained on different insulating varnishes, from which it will be noticed that the dielectric strength varies from about 2,000 to about 200 volts per mil. A baking-oil varnish cannot be considered satisfactory unless its dielectric strength when tested in the manner described is at least 1,000 volts per mil.

Air-drying oil varnish has usually a lower dielectric strength, particularly after ageing. Its dielectric strength, however, should not be less than 800 volts per mil. As spirit varnishes are so easily cracked it is very difficult to obtain consistent figures with this class of varnish, but if the tests are carefully carried out the

TABLE I.

Results of Drying and Ageing Tests on Insulating Varnishes.

Class of varnish.	Description.	Time to dry at 18-22° C.	Time to dry at 80° C.	Time to age at 80° C.
1. Baking ...	A clear cloth varnish ...	18 hr.	3 hr.	75 hr.
,,	,, coil ,, No. 1	18 ,,	3 ,,	340 ,,
,,	,, ,, ,, ,, 2	18 ,,	3 ,,	170 ,,
,,	,, ,, ,, ,, 3	40 ,,	3 ,,	230 ,,
,,	,, ,, ,, ,, 4	14 ,,	3 ,,	54 ,,
,,	A black ,, ,, ,, 1	12 ,,	2½ ,,	59 ,,
,,	,, ,, ,, ,, 2	200 ,,	12 ,,	1000 ,,
,,	,, ,, ,, ,, 3	500 ,,	12 ,,	900 ,,
,,	,, ,, ,, ,, 4	14 ,,	8 ,,	300 ,,
,,	,, ,, ,, ,, 5	70 ,,	7 ,,	500 ,,
,,	,, ,, ,, ,, 6	43 ,,	1½ ,,	160 ,,
2. Air drying	A clear coil varnish No. 5	24 ,,	3 ,,	200 ,,
,,	,, ,, ,, ,, 6	18 ,,	3 ,,	200 ,,
,,	A black ,, ,, ,, 7	12 ,,	2 ,,	5 ,,
,,	,, ,, ,, ,, 8	14 ,,	3 ,,	3 ,,
,,	,, ,, ,, ,, 9	12 ,,	3 ,,	3 ,,
,,	A clear core plate varnish	24 ,,	3 ,,	126 ,,
,,	A black ,, ,, ,,	14 ,,	3 ,,	3 ,,
,,	Hard drying copal varnish	10 ,,	3 ,,	300 ,,
3. Spirit ...	Black finishing No. 1 ...	3 ,,	10 min.	½ ,,
,,	,, ,, ,, 2 ...	3 ,,	15 ,,	2 ,,
,,	,, ,, ,, 3 ...	3 ,,	10 ,,	½ ,,
,,	,, ,, ,, 4 ...	14 ,,	1 hr.	3 ,,
,,	Shellac varnish	2½ ,,	10 min.	2½ ,,
,,	Anti-sulphuric enamel ...	12 ,,	1 hr.	3 ,,
,,	Mica sticking varnish ...	1 ,,	5 min.	1 ,,

results should show a dielectric strength of not less than 700 volts per mil.

4. *Acidity.*—In Table III are given the acidities of a considerable number of varnishes of each of the three classes mentioned. From the electrical point of view, the acidities should, of course, be as low as possible, but as varnish makers do not appear to be able to make a satisfactory insulating varnish without some acidity,

TABLE II.

Results of Dielectric Strength Tests on Insulating Varnishes.

Class of varnish.	Description.	Dielectric strength.	
		Before ageing.	After ageing.
		v/m.	v/m.
1. Baking ...	A clear cloth varnish ...	1,610	1,550
,,	,, coil ,, No. 1	1,490	1,500
,,	,, ,, ,, ,, 2	1,210	1,770
,,	,, ,, ,, ,, 3	1,770	2,000
,,	,, ,, ,, ,, 4	1,140	870
,,	A black ,, ,, ,, 1	1,440	660
,,	,, ,, ,, ,, 2	1,060	1,430
,,	,, ,, ,, ,, 3	370	510
,,	,, ,, ,, ,, 4	1,000	1,200
,,	,, ,, ,, ,, 5	580	960
,,	,, ,, ,, ,, 6	1,250	1,680
2. Air Drying	A clear coil varnish. No. 5...	1,360	1,330
,,	,, ,, ,, ,, 6...	1,280	1,500
,,	A black ,, ,, ,, 7...	640	580
,,	,, ,, ,, ,, 8...	1,250	260
,,	,, ,, ,, ,, 9...	280	280
,,	Clear core plate	870	870
,,	Black ,, ,, ...	1,360	1,610
,,	Hard drying copal	1,580	1,780
3. Spirit ...	Black finishing. No. 1 ...	250	250
,,	,, ,, ,, 2 ...	840	840
,,	,, ,, ,, 3 ...	117	117
,,	,, ,, ,, 4 ...	1,250	260
,,	Shellac varnish	750	700
,,	Anti-sulphuric enamel ...	140	140
,,	Mica sticking varnish ...	1,300	970

it would appear reasonable to accept as suitable varnishes which do not have a higher acidity than the average figures given in Table III.

5. ***Oil-resisting Properties.***—Provided the coils have been well baked before being placed in the oil, the oil containing the coil should be just as free from sediment after the heating test as a sample of oil which has been subjected to the same heat and has not had any contact with varnish. The baking-oil varnishes are usually found to be the best oil-resisting varnishes. The air-drying and the spirit varnishes are not as a rule so satisfactory in this respect, although some of these two classes of varnishes are suitable for use in oil-immersed apparatus, provided the temperature of the oil does not exceed 50 deg. C.

TABLE III.

Results of Acidity Tests on Insulating Varnishes.

Class of varnish.	Description.	Organic acidity in terms of SO_3	
		Before ageing.	After ageing.
		%	%
Black oil varnishes.	Clear coil varnish. No. 3 ...	2·1	1·4
	Black ,, ,, ,, 3 ...	1·1	0·8
	,, ,, ,, ,, 4 ...	0·5	0·3
	,, ,, ,, ,, 5 ...	1·1	0·6
	,, ,, ,, ,, 6 ...	1·1	1·3
	Average	1·2	0·9
Air drying oil varnishes.	Clear coil varnish. No. 7 ...	2·8	1·7
	,, ,, ,, ,, 8 ...	1·9	0·9
	Black ,, ,, ,, 10 ...	0·7	0·5
	Hard drying copal	1·8	0·84
	Average	1·8	1·0
Spirit varnishes.	Black finishing. No. 1 ...	4·6	3·7
	Shellac varnish	3·12	3·12
	Mica sticking varnish ...	2·7	2·2
	Black finishing. No. 5 ...	7·5	7·4
	Average	4·5	4·1

6. *Sticking Qualities Test Results.*—With the baking-oil varnishes it is always difficult to thoroughly dry the varnish which has penetrated beyond the first coil. This is due to the fact that the oxidation of the film of varnish on the outside of the coil prevents the varnish inside from taking up oxygen, and so prevents it from changing from a liquid to a solid state. It has often been found that the quicker the varnish dries outside, the slower it dries internally. After cutting the coil open in this test the adhesion can be readily ascertained, and is best compared by a parallel test on some insulating varnish which is known to be satisfactory in this respect. Air-drying oil varnishes and spirit varnishes have usually better cementing properties than the baking varnishes.

7. *Softening Temperature.*—Shellac and many of the gums employed in varnishes have a softening point of about 70 deg. C., and consequently varnishes made from these gums are not satisfactory for use on rotating parts. There are, however, other gums having higher softening points, which when incorporated with suitable oils form a varnish capable, when thoroughly dried, of remaining firm at a temperature of 80 deg. C.

TABLE IV.

Thermal Conductivity Test Results.

Current through coil.	Temperature rise.		Percentage difference.
	Unvarnished coil.	Varnished coil.	
1 ampere	17·5° C.	16·5° C.	5·7
2 ,,	77° C.	70° C.	9·0
2·5 ,,	123° C.	110° C.	10·5

8. *Thermal Conductivity.*—Table IV shows the results of some tests carried out in this connection, from which it will be seen that suitable varnish materially assists in reducing the temperature of the coil. The actual percentage difference between varnished and unvarnished coils depends upon the size and type of the coil employed, and the results of this test are best interpreted by comparing the figures with other figures obtained on an exactly similar coil with an insulating varnish which is known to be satisfactory so far as thermal conductivity is concerned.

ARMATURE BANDS.

By L. BURSTOW.

Strange as it may seem at first, there is no doubt that considerably more than half the number of armature-band failures are traceable to the bands being made of wire too large in diameter.

The reason that such wire is frequently used, especially on high-speed machines, is probably due to the fact that in putting bands on the armature to prevent the windings rising, due to centrifugal force, one is apt to overlook the fact that the stress on the bands due to the centrifugal force is not only not the only stress, but, in addition, is not the greatest, especially on small and medium-size machines.

On these armatures the greatest stress is that due to bending the banding wire round the armature, and as, on a given armature, the stress increases as the diameter of the banding wire, it will be seen that it is possible to put on a wire which is stressed beyond its elastic limit before any additional stress due to centrifugal force is thrown on it, and it is obvious that any wire so stressed and subject to alternate heating and cooling, as a banding wire is, is bound to have a limited life, and sooner or later must fail. It is, therefore, the writer's intention in this short article to show how the most suitable diameter of banding wire for a given armature can be found—that is to say, the diameter of wire which will give the lowest total stress.

Let D = mean dia. of winding in inches;
W = weight of copper in winding in lb.;
N = revs. per minute of armature;
d = dia. of banding wire in inches;
L = total width of bands in inches;
W/L = weight of copper per 1 in. of band = w;
D_1 = dia. of core in inches; and
L/d = number of wires in bands = n.

Now centrifugal force = ·0000141 D W N² and area of one wire = $\pi d^2/4$;
therefore, the stress tending to burst the band must equal

$$(\cdot0000141\ D\ W\ N^2) \Big/ \left(\frac{\pi d^2}{4} \times 2\pi \times \frac{L}{d}\right);$$

and this equals $(\cdot00000283\ D\ w\ N^2)/d$;
that is to say, with a given armature with a certain width of bands, the stress per square inch grows as the diameter of the banding wire becomes smaller. Then, in bending a wire around the armature the outside is increased by and the inside decreased by $d\pi$; that is to say, that in $(D_1 + d)\pi$ there is a stretch of $d\pi$, and, as d is very small compared with D_1, we can, for all practical purposes, say that this stretch takes place in $D_1\pi$; that is to say, in D_1 there is d stretch.

Now, the stretch or extension is a measure of the stress, and steel wire stretches about ·0009 in. per ft. per ton; therefore, the stress = $(2{,}240 \times 12\ d)/(\cdot0009\ D_1)$ in pounds. This equals $(30{,}000{,}000\ d)/D_1$.

There is one other stress: that due to its own weight.

The weight of a single turn of wire is equal to $\pi d^2/4 \times D_1 \times \pi \times \cdot283$, so the centrifugal force equals

$$(\cdot0000141\ D_1 \times \frac{\pi d^2}{4} D_1\pi \times \cdot283 \times N^2) \Big/ \left(\frac{\pi d^2}{4} \times 2\pi\right),$$

and this equals ·000002 D_1^2 N².

Now, taking the max. speed of a banded armature as 9,000 ft. per minute or 150 ft. per sec., at this speed D N = 34,000. Therefore, at this speed the stress

= ·000002 × 34,000²
= 2,400 lb. per sq. in.,

and this can be neglected, as at this speed the bands would from other sources be stressed to at least 100,000 lb. per sq. in., and, as can be seen, this is under 2½ per cent. of that figure; therefore, all we have to concern ourselves with is the other two stresses.

Although the breaking strain of the best banding wire is about 300,000, the elastic limit is about 150,000 lb. per sq. in., and this must not be exceeded; in fact, the total stress, where possible, should be kept under 100,000.

We have already shown the stress due to centrifugal force, and I think it is obvious that the tension put on the wire when banding must be greater than the tension set up in the wire due to the centrifugal force, otherwise directly the tension due to centrifugal force exceeded the initial tension there would be movement of the coils owing to the bands stretching, and once there is movement (other than that due to heating and cooling, which one cannot control) of coils then, especially in a machine which changes speed frequently, such as a crane motor, it is only a matter of time before the insulation breaks down.

In order to be quite on the safe side, it is advisable to make the initial tension about one and a-half times the tension due to centrifugal force; this will then allow for the machine speeding up slightly for various causes, such as light load, &c.

The total stress then becomes

$$\cdot00000425\ D\ w\ N^2/d + 30{,}000{,}000\ d/D,$$

and the stress will be found to be lowest when these two are equal. Now, taking a number of standard machines by various makers, I find that the weight of copper per 1 in. of band approximates very nearly to D; therefore, making use of this, we get, if we take D equals D_1,

$$\text{total stress} = \cdot00000425\ D_1^2\ N^2/d + 30{,}000{,}000\ d/D,$$

and noting that D_1 N for 80 ft. per sec. (which is about the highest peripheral speed a standard machine would be expected to stand without increasing the bands) is 18,300,

we get $\cdot00000425 \times 18{,}300^2/d + 30{,}000{,}000\ d/D_1$
$= 1400/d + 30{,}000{,}000\ d/D_1$,

and the stress will be found to be at its lowest when these two are equal—

that is, $1{,}400/d = 30{,}000{,}000\ d/D_1$;
$d^2 = D_1/21{,}400$; $d = \sqrt{D}/150$ approx.;

then $\sqrt{D}/150$ gives best dia. of banding wire for standard machines. This gives a stress of 125,000 at 80 ft. per sec. on 10 in. dia., and this stress will be greater on diameters smaller than 10 in. So when the speed exceeds 80 ft. per sec. the width of bands should be increased to suit, and when this cannot be done the band should be put on in two or more layers to get the required number of turns, taking care that each succeeding layer is put on with a tension less than the previous one, otherwise the inner layers become slack, and the whole tension due to centrifugal force is thrown on the outer one. A very good rule is to drop the tension 20 per cent. on each layer.

Of course, all the remarks only apply to the final bands and not to the preliminary bands, which are put on to bed the winding well down. These, of course, can be larger, and the initial tension can be as large as the wire will allow. I think if the points brought out were kept in mind when getting out bands for high-speed machines, we should hear very little of band failures.

"Leader" Cable for Aircraft.—Admiral Fournier has communicated to the Académie des Sciences an account of successful tests of apparatus for the guidance of aeroplanes to their aerodromes by night or in fog carried out at Villacoublay by Lieutenant Loth, of the French Navy. Lieut. Loth has devised a similar device to the "Leader" cable for aeroplanes which adds less than 10 lb. to the weight of the machine. On the ground there is a guiding cable with an alternating current of 600 cycles per second. In the machine there are three receiving devices. One of them records a deep and loud musical sound—which the pilot hears with the aid of ear-pieces fixed in his helmet—so long as the machine is flying parallel with the cable. The sound diminishes when the direction of the machine makes an angle with the cable, and ceases altogether when the direction is at right angles to the cable. The second spiral records its loudest sound when the machine is flying at right angles to the cable and ceases to record when the aeroplane is going parallel. The sound recorded by the third spiral varies according to the distance of the machine from the cable, but it stops the moment the machine crosses the cable. The sounds can be caught as high up as 10,000 ft. and for a mile and a half on either side of the cable.—*The Times.*

"HANDS OFF" THE ELECTRICAL INDUSTRY.

Sir Peter Rylands's Speech on German Super-Power Stations for England.

We had not before us last week, when our leading article on "'Hands off' the Electrical Industry" was written, a verbatim report of the speech delivered by Sir W. Peter Rylands at the meeting of the Federation of British Industries. A very full account of the proceedings appeared in the *Bulletin* of the Federation, and in view of the extreme importance of the subject, we are now placing on record below the parts of the speech in which Sir Peter's "dangerous suggestion" was described. We also quote the views expressed by *The Times* Trade Supplement, and extracts from a speech by Herr. Rathenau follow. In our concluding paragraphs we quote from an important speech delivered by Sir Robert Horne, the Chancellor of the Exchequer, on Monday last, in which Sir Robert showed that the danger to the electrical industry was recognised by, at any rate, some of our political leaders now in authority.

Sir Peter Rylands had been delivering a lengthy speech dealing with the objections to the indemnity in its present form, and the need for the form of Germany's payments to be controlled, and he proceeded to discuss ways in which German energy might be diverted into what he regarded as useful channels. He continued as follows:—

I suggest that if we could impose on Germany, by agreement with our Allies, the obligation to build railways under our direction and control—docks, harbours, or any scheme of development which had reasonable prospects of being self-supporting in the near future and could be handed over under some terms to the country benefiting—I suggest that by this policy we should be diverting German energy into a channel which might be of enormous benefit not only to Great Britain but to the world at large.

I know suggestions of that kind have been received with a little doubt because it has been thought that they would give Germany opportunities of peaceful penetration into some new country, but I submit that if that course were found practicable, and if we could carry out such work under the direction of the Allies, by Allied engineers and to the Allied specifications, it would redound much more to the credit and the moral benefit of the Allied nations than to the hewers of wood and drawers of water—the Germans who would be performing the work. I do not want to particularise too closely, but one cannot shut one's eyes to the fact that Russia is a country of enormous potentialities, one of the granaries of the world, a country with almost boundless possibilities, a country whose development has very largely been arrested by the failure of its Government in the past. It is true that at the moment the political position of Russia is very ambiguous, but there are reasons for thinking a change is taking place, and I do not despair entirely of the possibility of the Allies taking some portion of Russia in hand, with the consent of the Government, and developing it, always having in view the object of the rehabilitation of Russia, not exactly as a political nation, but as a source of supply of food and agricultural produce of all kinds. That is a line of thought as to the possibility of developing the waste places of the world in connection with this indemnity in directions in which, as I suggested, there is no early probability of the work being put in hand in a normal way.

Now we come to the reflection whether there is not something we could do to cheapen our own cost of production to our own friends. It must be admitted that in almost any work, whether it be of the character I have been hinting at, or in the direction upon which I now propose to speak, it would be possible for British manufacturers to suggest that work is being done which they themselves were not incapable of performing. I would beg that we do not examine this problem with too particular a criticism of that kind. Always let us bear in mind the converse of the proposition—the alternative that we have to face. If the reparations are uncontrolled, we have to face competition from Germany in iron, steel, machinery, electrical plant, textiles; every single commodity which it makes, and in which we too are interested, will be flooding the world, at prices which must defy competition as a natural economic consequence of the situation. So supposing it is a fact that certain of these alternatives might be considered to involve the use of commodities which we ourselves are capable of producing, we must always remember the alternative of the peril which British industry would run from the absolute uncontrol of German payments in goods.

I will put my dangerous suggestion first: Some two or three years ago a Committee was appointed by the Government to consider the question of electrical power, and it was reported—and I believe that all of us manufacturers are sensible that it is so—that it was a lamentable fact that throughout the whole of industrial Britain the power units were small in size, very many in number, and widely divided in control; that there was no real efficiency in the production of power. It was recommended that it would be desirable to consolidate these plants; in some way to erect in each district a great super-power station which would enable the manufacturers of that district to obtain their power at the lowest possible cost at which power on the largest possible scale of production could be made. That recommendation was received, generally speaking, with approval, but it was obviously open to very serious objections. One of the objections, perhaps the most serious, was that it would involve the scrapping of such an enormous amount of plant that the capital loss involved would more than outweigh the benefits of the new installation. That was perfectly true, and a not altogether unfair criticism, but there was always this further difficulty: that whether that were so or not, the cost involved was so heavy that under existing conditions it was quite inconceivable that any local authority, the Government or anybody, could provide the millions of money that we required in order to advance a scheme of the magnitude which was in mind.

Now, gentlemen, I am confident that there was a great deal in the suggestion that if we could arrange that the power that was produced in any particular industrial centre over a large area was centrally produced with the greatest economy of fuel and the most efficient production, it would be possible for us to have our power at a very much lower cost than it costs us to-day. This problem has come to the forefront all the more because of our anxieties with regard to coal. The price of coal is undoubtedly excessively high, and with the high cost of railway transport the cost of our power is correspondingly exaggerated, and, speaking for myself, I should be prepared to go as far as this: I should be prepared to say that it would be in the interests of this country for the Government to lay down in every industrial centre in this country, the very best super-power station at the complete expense of Germany, and with a zero capital cost to this country. I believe that if any of us who are dependent upon power in this form could imagine the whole of the existing municipal and other plant in our own district scrapped and its place taken without a penny of extra charge, by a super power station of the magnitude contemplated, I am satisfied we would feel an enormous sense of relief both from the point of view of the probable cost of that power to ourselves and that of the advantage of having an indefinitely large supply always open to us in case of need. Now it is possible that certain electrical interests would at once protest. In reply to that I would like to suggest, first, that there is no earthly prospect of this thing being carried out otherwise under existing conditions, if ever. On the other hand, supposing it were carried out, and the benefit which we are promised accrued, electricity would become the cheapest power in this country, and every manufacturer would at once order motors in order to avail himself of the cheap power that had been provided.

I suggest, gentlemen, that this is a field of inquiry well deserving of examination, and I mention it because it seems to me it would involve very large sums of money, and if the same policy were pursued by France and other of the Allied nations, I can conceive that the amount of orders that would be placed with Germany in satisfaction of requirements of this kind might reach such magnitude that it would make a large hole in the moment that it has to pay. The result would be that instead of German competition making an addition to our difficulties, it would be a German force that would reduce our own cost of manufacture, and contribute to that extent to our prosperity. I mention the electrical question without desiring to dogmatise. I am not an electrician, nor an electrical engineer. I use electrical power, and as a user I appreciate very highly the importance of low cost per unit, just as I deprecate most seriously the present extraordinarily high price that I have to pay. If I can see, by any arrangement of this kind, a reduction of the unit cost to something like the figure I think it ought to be, I am satisfied it would pay my firm very well to use electricity more than it does to-day.

Once you have accepted the principle, providing the advantage to the manufacturer is sufficient to outweigh any disadvantages resulting from the possible loss of business, it does open other possible avenues. For instance, one might mention the Channel Tunnel.

Some discussion followed, and in his reply thereto Sir Peter Rylands thanked those present for their sympathetic reception of his statements, and said that the useful comments made would be carefully considered by the Reparations Committee.

He quite appreciated that there was a distinction between work to be done in Germany and the actual work of erection. The labour in relation to the material would obviously vary very much in different jobs. It was doubtful whether it would be consonant with the wishes of the people of this country that the Germans should come over here and do the work. The method adopted would be, *in the case of electrical installations*, which he had instanced by way of illustration, *to order the machinery from Germany*, but leave the installation to the labour on this side, as the labour cost would be small in comparison with the cost of the plant. On the other hand, if a railway were being put down in some distant part of the world where the labour cost was high in relation to the material, it would seem advisable to impose upon the Germans the ordinary contractor's liability of arranging for the payment of the people employed. That payment would have to be made out of export of goods from Germany, but it would be a direct charge on Germany so far as the material was concerned, which at all events would employ a certain amount of the German exportation, and *pro tanto* liquidate their liability under the reparation. It would not seem desirable to lay down hard and fast suggestions or to go into too much detail, but it would be reasonable to demand that where any work of this nature was undertaken, the interests in this country which were likely to be affected by it should be consulted in order to obviate any charge that British interests had been neglected.

The Times Trade Supplement, in its leading article on "Reparation Payments" (December 3rd, 1921), makes the following comments on the above matter:—

"Sir Peter Rylands, the outgoing President, suggested central super-power stations and the Channel Tunnel. . . . It is urged that unless subsidised in this form many excellent and ultimately profitable enterprises will be indefinitely postponed, and it has been argued that the erection of the plant, the preparation of sites and other work incidental to such projects would find employment for a great mass of British labour. Against this argument there is the obvious objection that to divert the industrial capacity of our late enemy into activities connected with the manufacture of engineering and electrical installations would tend to foster in Germany those very industries most likely to be useful to her in the event of another war. Already our own engineering trades are finding it difficult to secure enough contracts to keep a portion of their plant and staff occupied. Indeed, the Government, to a chorus of general approval, recently decided to set aside £25,000,000 for the purpose of assisting enterprises which had as their object the erection of reproductive works which in the present state of finance would not otherwise be undertaken, and this policy was deliberately adopted for the relief of unemployment. Yet however attractive it may appear to get something for nothing, the Government will indeed be shortsighted if it does not take into account those ultimate consequences which in the life of a nation far outweigh in importance immediate advantages. *Timeo Danaos et dona ferentes.* The lessons learned in the fourth form room seem to have been forgotten by many of riper years. . . . When the scales fell from the eyes of the British nation in the opening months of the war men recognised the past subtlety and ingenuity of the German rulers, not only in regard to their military policy, but in the steps which had been taken to undermine the industrial position of their neighbours and particularly of the British Empire. Men saw then what would have been the real cost to our commerce of cheap dyes and chemicals from Germany; they recognised that even cheap ocean freights, if granted with the design of driving the British mercantile marine off the seas, would have brought about our undoing; they saw at last why Germany had secured the monopoly of such key industries as the manufacture of hosiery needles, magnetos, and optical instruments. What is blinding them now?

"In those days of stress everybody realised the sinister purpose of Germany's commercial policy. To-day the depreciation of the mark is undermining British trade. Many persons believe that the financial policy of Germany since the Armistice has been designed with no other object. Last week the discovery of 150 new guns in Germany was announced; this week a further 400 new howitzers have been reported. Can such evidence be safely ignored? . . . The safety of the realm must be the first consideration of all patriotic citizens; and however great the temptation to secure reparation from Germany by enabling her to rehabilitate her most formidable industries we trust that there are still sufficient men of character and intelligence among our Ministers to resist the proffered gifts and to refuse to entail upon our descendants the legacy of future strife."

It may be interesting if we reproduce here from the *Economic Review* of October 14th part of an address delivered by Herr Rathenau at a largely attended meeting of the Association of German Industries held in Munich on September 28th. He was speaking on his recent conference with M. Loucheur at Wiesbaden with reference to Germany's payments in kind. The following report appeared in the *Kölnische Zeitung* (September 29th):—

"It is to our interest not to have to obtain further gold values on such a scale, but to deliver material values. The problem for us is one of replacing payments in gold by payments in kind. On the other hand, it cannot be a matter of indifference for us as to what industries are to undertake the heavy tasks demanded by French reconstruction. It goes without saying that the French industries will secure for themselves a considerable part of the work. Their capacity, however, has its limits. The French Minister for the liberated districts has pointed out to the French industries that they would be injuring themselves were they to devote all their energies to the work of reconstruction, since in that way they would vanish from the world's markets. It would appear that the French industries have recognised this, and that they intend to leave us a large share in the reconstruction. For us this question is very important, not only because by such services economic relations are engendered and extended, but also because it is still difficult to predict what amount of employment there will be in the industries of Europe during the next few years. At the moment we have no unemployment; on the other hand, the factories are not in a position to satisfy all claims made upon them. That is due to the terrible depreciation of the mark. When once internal conditions have again been stabilised, and should the mark rise again, it will be impossible to foretell whether we shall still have the same amount of employment. In view of the peace conditions and of the ultimatum, the amount of employment in foreign countries for the next few years will be extraordinarily small. Our economic system is busily employed to-day and we shall make technical advances, such as only a busily employed economic system can make. For that reason a mutual agreement with our neighbour States is essential. The idea which has dominated the agreement with France with regard to payments in kind is that in the domain of special goods required, of machinery, of plant on a large scale, free trade shall prevail, and that only a system of reckoning shall be created which will make it possible for French manufacturers to purchase from German manufacturers on the basis of free agreements, and to book the goods thus acquired to the reparations account. . . .No greater service can be done to Germany's economic system than by producing from home raw materials. Whoever enables us to dispense with foreign raw materials deserves the civic crown. This point should be seriously considered by our economic leaders. Germany won her great economic position not by wealth, not by her geographical situation, but by forces which are still operative to-day: organisation, discipline, scientific knowledge, work, and a strong sense of duty. If we retain these forces our economic system will revive, no matter what burdens other nations to-day threaten to impose upon us. In the long run it is not wealth and political power that decides but moral power and moral will."

The Chancellor of the Exchequer (Sir Robert Horne), speaking at a meeting at Manchester on Monday, commented on the case against payment in kind as follows:—

"It was suggested that Britain should, like France, obtain some portion of her reparations by means of payment in kind. That was the principle of the Loucheur-Rathenau agreement. But we were in a very different position from France in regard to this. The payments in kind which were to be made by Germany to France were connected with the devastated regions, and there was work to be done, in restoring villages, which were wiped out of existence, which could not be accomplished in any near period of years, though all the labour in France were devoted to the purpose. Accordingly it was possible for Germany to make payments in kind to France without interfering with the ordinary course of French employment.

"The situation was very different with us. *For the most part the things Germany could give us in the shape of payment in kind would be just the kind of articles we could make ourselves.* There were one or two commodities like potash or sugar from which we could obtain a certain amount of reparation by payment in kind, but all that those articles would yield was a mere bagatelle in relation to the amount due. *We would be offered payments in kind in such things as electrical machinery, locomotives, rolling stock, and so on. But what was going to be the effect upon our own trade and employment under these circumstances?* (Cheers.) *These were the very things which we ourselves manufactured and upon which the very existence of many of our workpeople depended.*"

THE HELSBY TWIN WIRING SYSTEM.

In view of the interest that is taken in the subject of metal-sheathed wiring systems it is not inappropriate to point out that the advantages claimed for the twin wiring system of British Insulated & Helsby Cables, Ltd., are that it is (1) inexpensive; (2) easily and rapidly erected, fittings are few, it is adaptable and substantial, loose screws and small loose parts are practically eliminated; (3) neat in appearance and does not detract from that of existing decorations; (4) that efficient electrical continuity of the metallic sheathing of the cable is secured by the use of a bonding clamp of the same metal; and (5) that no special tools are required to aid erection.

The system is suitable for either a d.c. or an a.c. supply, and comphises single, twin, or three-core cable, together with a range of fittings and accessories. The single wire is of circular section, but the twin and three-core cable is of flat section, and the overall dimensions have been kept small, so as to assist unobtrusiveness when erected on the surface.

The metallic sheathing of the cable is composed of a special alloy of sufficient strength to provide, it is said, a good protective covering for the cable without impairing its flexibility, and, at the same time, to prevent it sagging between properly-spaced points of support. Moreover, it is claimed that the whole system can be quickly and cheaply erected with a minimum of labour and without the use of special tools; that it presents a neat appearance when installed, and complies fully

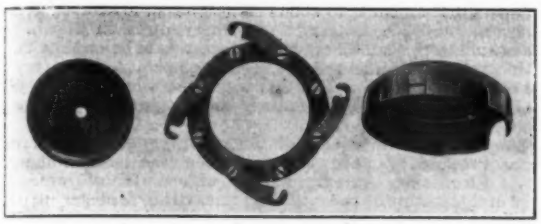


Fig. 1.—The Helsby Junction Box.

with the requirements of the I.E.E. Wiring Rules, fire insurance companies, and electricity supply authorities.

The high-conductivity tinned-copper conductors are insulated with pure, vulcanised, rubber and taped so as to possess distinctive colours; the cores are sheathed with a solid-drawn tube of special metal alloy, and the test pressure employed is 1,000 volts alternating for 15 minutes after 24 hours' immersion in water at a temperature of 60 deg. F. The three types of cable named above are made in a variety of sizes, their approximate overall dimensions varying from 0.208 to 0.58× 0.976 in., and their weights from 3.2 to 34.85 cwt. per 1,000 yards.

Generally, tinned brass fixing clips and saddles are used, but for cleating cable in damp situations it is recommended that a metal strip of approximately the same composition as that of the cable sheathing should be used. The junction box is illustrated in fig. 1, and comprises a tinned brass back-plate and cover and an annular bonding clamp. The back-plate is placed inside the latter, and the whole is secured to the wall by means of a screw through the hole in the plate The bonding clamp is provided with four slots, so that it may be used as a two-, three, or four-way fitting, and continuity of the metal sheathing of the cable is secured by screwing down the small clamping pieces on to the sheath. The metal alloy of which the bonding clamp is made is of the same composition as that used for sheathing the cable, and when it is necessary to

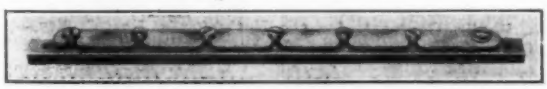


Fig. 2.—The Helsby Bonding Bar.

use a larger cable than 7/.029 in. flat twin, the slots can be easily enlarged without the aid of special tools, a pocket knife being all that is necessary. The fitting is supplied with all the loose screws and parts assembled, and it is never necessary to remove any of them completely; the long nuts embedded in the bonding clamp practically obviate the trouble experienced with stripped screw threads, while the cover for the fitting is simply sprung on to the base portion.

The universal bonding clamp is similar to the annular one, but it has no back-plate or cover. It is suitable for use under wood pattrasses, the latter being specially recessed for the purpose, and have an imitation walnut finish. Porcelain insulated connections are used with the junction box, and the bar for bonding the metal sheaths of cables together at distribution boards, which is illustrated in fig. 2, normally has six spaces for cables, but may be cut up and used in shorter lengths when necessary. The earthing clips are suitable for fixing to metal pipes or a similar medium, and are adaptable to any size. For securing clips, saddles, &c., to any sort of material, Rawlplugs are used, while it is recommended that a protective steel covering should be placed over the cable in situations where there is a risk of mechanical damage, and to supppt it where it crosses ceilings, &c.

Foreign Glassware.—*The Times* states that the forthcoming inquiry into the application of the glass industry for protection under Part II of the Safeguarding of Industries Act is being awaited with much interest. Selling prices of foreign glassware in London are said to be equal to, and in some cases below, British labour costs.

THE EAST MIDLANDS ELECTRICITY DISTRICT.

The above-named district was preliminarily delimited by the Electricity Commission about a year ago* in connection with the proposed re-organisation of the supply of electricity therein, and we understand that a conference of the authorities concerned has made considerable progress during the last few weeks with the consolidation of a scheme covering a wide area of the East Midlands and affecting jointly the public authorities of Nottingham, Leicester, Derby, Burton-on-Trent, Loughborough, Mansfield, Long Eaton, and Newark, the project providing for the establishment of four main generating stations, one at each of the first four named places, with possibly a fifth station of smaller size at Newark; the whole providing for plant approximately of a total capacity of 500,000 kW. After long preliminary discussion between representatives of the several bodies concerned, an application has now been submitted to the Electricity Commissioners for the establishment of a Joint Electricity Authority. The Nottingham Corporation, which has obtained the consent of the Commissioners for its own scheme of independent supply, involving the construction of a large generating station in the neighbourhood of a colliery and contiguous to the river Trent at Clifton, close to the municipal boundary, has expressed approval of the joint scheme, being satisfied that it cannot adversely affect the city's interests, and it is proposed to accord it support at the local inquiry which is shortly to be held, provided that the interests of the Corporation are not adversely affected by any proposed amendment.

It has been suggested as an outcome of conferences between the several authorities, that the Joint Authority shall consist of 20 members, 12 to be appointed by local authorities supplying electricity in the district as follows: the cities of Leicester, and Nottingham, the county boroughs of Burton-on-Trent, and Derby, two each; the boroughs of Loughborough, Mansfield, and Newark, and the urban district of Long Eaton, one each; one member each to be appointed by the County Councils of Derbyshire, Leicestershire, and Nottinghamshire; one member to be appointed by the companies supplying electricity in the district, viz., the Derbyshire and Nottinghamshire Electric Power Co., and the Leicestershire and Warwickshire Electric Power Co.; two members to be elected by the railway companies purchasing electricity from the Joint Authority or one of its constituent members, and two members to be elected by other large consumers of electricity. In addition to the proposal as to the erection of new main stations, provision is made by the scheme for the existing stations in the smaller towns to continue in operation until it is economically practicable to replace them by a bulk supply from a main station. In the first instance it is not proposed that the Joint Authority should take over any of the stations, but as the demand for electricity extends in the area between the several main stations, it may be necessary for the Joint Authority either to take over a station or stations, or to link up such stations to enable them to give a supply of electricity in the intermediate area. As to distribution, it is proposed that the areas of distribution of local authorities shall be extended considerably beyond their present boundaries, and that the Derbyshire and Nottinghamshire Electric Power Co., and the Leicestershire and Warwickshire Electric Power Co., shall continue to be the distributing authorities in the areas covered by their respective provisional orders. It is also intended that the Melton Mowbray Electric Light Co., Ltd., shall continue to be a distributing authority within its present area, and that the Joint Electricity Authority shall exercise distributing rights in those parts of the district which are not served by any of the before-mentioned authorities. The area which the committee suggests, should be the extended area for the supply of energy by the Nottingham Corporation is as follows: The urban districts of Arnold, Beeston, Carlton, Hucknall, and West Bridgford, and parts of the rural districts of Basford, Stapleford, and Bingham. When sanction was given by the Electricity Commissioners to the Nottingham Corporation for the erection of the new generating station on the banks of the Trent, it was made a condition that the Corporation should, if required by a Joint Authority and if so directed by the Electricity Commissioners, transfer such station to the Authority upon the terms mentioned. The scheme further provides that the expenses of the Joint Authority shall be met and defrayed by (1) the proceeds of the sale of electricity and revenue derived from the business of the Joint Authority; (2) grants from the Imperial Exchequer made upon the recommendation of the Commissioners, and (3) such contributions as may be made by constituent authorities. Provision is also made for capital and revenue accounts, borrowing powers, &c.

The *Nottingham Guardian* points out that Ald. E. Huntsman, chairman of the Nottingham Electricity Committee, is also chairman of the conference which has submitted the scheme.

*Elec. Rev., November 5th, 1920; p. 591.

JAPAN AFTER THE GREAT WAR.

The following is a summary of certain portions of the report on Japan by Mr. E. F. Crowe (Commercial Counsellor), and Mr. G. B. Sansom (Commercial Secretary), at Tokio, to which reference was made recently in our editorial columns.*

During the years 1914-18, while other countries were consuming capital wealth and piling up colossal debts, Japan, thanks to successive favourable trade balances and a virtual monopoly of the carrying trade on many routes, developed from a debtor into a creditor country. The total increment of wealth derived by her from international transactions is estimated at from 2,500 to 3,000 million yen, say £250,000,000. The amount of money, whether in currency or credits, was more than trebled, but there was not a corresponding increase in the volume of commodities produced or imported for home consumption, nor was there any sensible enlargement of services (*e.g.*, communications) as distinct from goods. The consequence was an increase of prices to about three times their pre-war figure, and a speculative boom which lasted into 1920.

The story of the subsequent and rapid collapse is too well known to need recapitulation. Depressed conditions persisted until June, 1921, when some signs of recovery became apparent. Complete recovery must depend, as did the depression, to a large extent upon the conditions in Europe. It was not due to any fundamental defect in Japan's economic position, but arose from an excess of money which could not be turned into goods. The inflation in Japan, though accompanied by the same evils, was not of the same nature as the inflation in European countries, for it represented a real increase in wealth, and not an artificial creation of credits.

The Governor of the Bank of Japan recently urged that this wealth should not be hoarded, that costs of production should be reduced so as to stimulate export trade, and that stocks bought at war prices should be written off.

The Metal Trades.

No line was more overdone than metals, and many firms who had had little experience in this direction made huge speculative purchases. For this reason, and owing also to a great increase in domestic output, stocks have continued very heavy.

The Imperial Steel Works at Yawata have been producing satisfactorily as far as quantities go, but at too high a cost, and as reductions in price have had to be made in order to allow of competition with imported goods, the works are said to be once more running at a loss.

Japan suffered from the need of iron very badly during the war, when her shipbuilding yards and many other plants were held up for lack of necessary materials. The profits to be made out of iron at the prices then ruling seemed so attractive that a great many works were started, some of them on a very extensive scale.

Many works have gone under, so that, on the whole, the outlook for Japan's iron and steel industry is not promising, and yet, if Japan wishes to attain a position of eminence in the manufacturing world, she must have cheap iron.

Notwithstanding this fact the authorities consider that it is necessary to encourage domestic production, and have accordingly increased the tariff to an *ad val.* duty averaging about 15 per cent. Drawbacks, however, will be granted on iron and steel used in shipbuilding and other specified industries.

Great results are expected from a new invention for making pig-iron from iron sand, which has recently been patented by a Japanese scientist. The laboratory experiments are said to have satisfied the military authorities, and it is alleged that work on a commercial scale will be commenced soon. It is estimated that from this iron sand, of which there are enormous deposits, pig-iron can be produced at a cost of 30 yen per ton.

The Market for Machinery.

In spite of the increased production of machinery, especially of electrical machinery, in Japan, the import continues to grow, and it is safe to prophesy that the more her industries develop the more machinery she will purchase from abroad, as it will be a long time before she is in a position to supply all her requirements.

In 1919 and 1920 she bought machinery and parts to the value of 89 and 110 million yen respectively, and for the first six months of 1921 she imported 68 million yen's worth, so that the returns for the whole year should undoubtedly register a record.

In 1914 the United Kingdom enjoyed nearly 50 per cent. of the business, and Germany and America shared most of the balance between them.

The following table shows how the business was divided in 1919, 1920, and for January-May, 1921 :—

	Year 1919. 1,000 yen.	Year 1920. 1,000 yen.	Jan.-June, 1921. 1,000 yen.
United States ...	66,866	73,536	39,418
United Kingdom ...	16,144	28,423	21,634
Sweden	2,455	2,262	1,613
Switzerland ...	1,314	565	995
Other countries ...	2,221	5,214	4,340
Total	89,000	110,000	68,000

* Department of Overseas Trade. "Japan," 1921. price 2s.

It will be seen that the British share is gradually advancing.

Switzerland and Sweden, who figure so prominently, owe their place chiefly to the machinery required for the big hydro-electric plants, in which there has been a great boom in recent years. Japan is very well supplied with rivers, and in view of the advance in the price of coal, it is only natural that the attention of power consumers should have been turned to water.

The water turbine machinery for the various plants executed and on order since January, 1920, up to the end of June, 1921, amounts to about 260,000 b.h.p. machinery ordered abroad, and 150,000 b.h.p. machinery made in Japan. In addition to this another 250,000 b.h.p. was to be ordered during this year, including the 190,000 b.h.p. plant of the very big Formosan Hydro-Electric Co., a scheme which is of a semi-Government nature, and which will supply power to the whole of Formosa.

Proposed Electrical Amalgamation.

One of the most interesting features of the year has been the large number of amalgamations of electric companies that have taken place. The Minister of Communications is said to be in favour of a proposal for bringing under one management all the electric companies in Japan. If this were possible the concern would be one of the largest in the world. As a preliminary step a great many minor mergers have already taken place of companies operating in different districts. The Associated Electric Power Co. (capital 100 million yen) is composed of three leading companies, and will absorb three more, thus having control of Central Japan. The Tokio Electric Co. will take over four or five more companies, and will increase its capital to nearly 200 million yen. In the Hokkaido the Fuji Electric Co. has absorbed five other companies. In Kyushiu an amalgamation of all the big and small companies operating in the island is under consideration.

Electrification Schemes.

The Government's railway electrification plans have been modified owing to financial stringency. Under the original scheme a semi-official electric power company was to be formed in Tokio with a capital of 100 million yen. The programme has been approximately halved. The work now contemplated will take about five years, and will be looked after by an electric bureau, which has been newly created in the Department of the Imperial Railways.

The present electric tramways, which are under the Imperial Railway Department, have a mileage of only 58 miles, but a further 177 miles will be electrified by 1926. There is also a scheme for the construction of a high-speed electric railway between Tokio and Nikko.

Public Contracts for the Netherlands East Indies.—The Commercial Secretary to H.M. Legation at The Hague has submitted to the Department of Overseas Trade a report on the subject of tenders for public contracts in the Netherlands East Indies. In the case of contracts for materials for public works, railway material, dredging plant, cables, constructional iron and steel and the like, foreign firms may lodge tenders with the Colonial Office at The Hague without the necessity for local representation in Holland. As regards contracts for the supply of general merchandise, and articles of miscellaneous description, however, public tenders are invited by the Colonial Establishment at Amsterdam, and are accepted only from firms having properly accredited representatives in the Netherlands. For the purpose of this regulation it is sufficient for the firm to have in Holland an agent of good standing, that is to say, that the foreign firms tendering need not be actually "domiciled" in the Netherlands. The Commercial Secretary adds that this limitation of the field of acceptance is intended to serve as a protection, in the case of dispute and to ensure, as far as possible, the enforcement of penalties in the event of breach of contract. The Netherlands Government does, nevertheless, from time to time, invite foreign firms having no agent in the Netherlands, to tender directly for miscellaneous goods. These tenders are called private tenders, to distinguish them from public tenders, the rules governing which are outlined above. The Department of Overseas Trade will be pleased to suggest suitable agents to United Kingdom firms not represented in the Netherland on receipt of details of their requirements, quoting the reference number 11,962/FW.

Concerted Action to Safeguard the Electrical Industry.—The Electrical Section of the Newcastle-upon-Tyne Chamber of Commerce has discussed the Safeguarding of Industries Bill, and passed the following resolution: "This Committee recognises the necessity of some strong concerted action to safeguard the electrical industry as a means of helping to cure the present serious unemployment, and to counteract the effect of unfair competition arising out of the depreciated currency of certain European countries, and of the importation of goods below the cost of production."

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Hall-Mark" Copier.

The production of blue prints, which is an essential function of large engineering firms, and especially electrical concerns, can be a very tedious process. A means of printing which combines speed with efficiency is, therefore, to be welcomed. Such a means is provided by the "Hall-Mark" printing machine, designed and made by Messrs. B. J. Hall & Co., Ltd., Chalfont House, Great Peter Street, S.W.1. Fig. 1 is an end-view of the machine, which gives a good idea of the main features. A "Hall-Thorkelin" lamp is made to move to and fro in a glass bend or trough. Passing under this trough is an endless canvas sheet stretched tightly over three rollers. The printing paper and tracing are inserted between the canvas and the glass, and are taken through at a speed adjustable to a fine degree. The motive power for both the lamp and the canvas is provided by a ¼-h.p. motor. The speed of the canvas is adjusted by two methods. First there is a two-speed gear box operated by a gate lever. On this the higher speed is twice the lower. Fine variations are made by altering the position of the driving belt upon two conical pulleys. A countershaft in the base of the machine is rotated by means of the enclosed gear, and from this shaft a double chain extends to a sprocket wheel at the other end of the machine. A stud on this chain forms a limit to the travel of the lamp, and when it reaches the wheel, the direction of travel is changed by a simple but ingenious reversing movement. The "Hall-Thorkelin" lamp, which forms a part of this machine, is worthy of special mention. As will be seen from the line drawing, fig. 2, it has a scissors-type arc, giving a powerful shadowless light with a current consumption of about 10 A, enclosed in a glass globe approximately 8 in. in diameter. The carbon-feeding movement is actuated by a solenoid, which moves a counterweight attached to the holders. By this means a feed of four or five inches is obtained. In addition to these main features several refinements are embodied in the machine. A chest at the rear contains a roll of printing paper, and this may be brought up to the point of entry through a slot. When it is desired to clean the lamp or to renew carbons, an extension of the runway in which the lamp moves is provided at one end, so that the lamp can be brought out clear of the machine, and all parts are accessible. The overall (floor space) dimensions of the machine are, roughly, 7 ft. by 5 ft. With electricity at 5d. per unit it is calculated that from 50 to 120 or more double-elephant prints can be made in an hour at a cost of 10d.

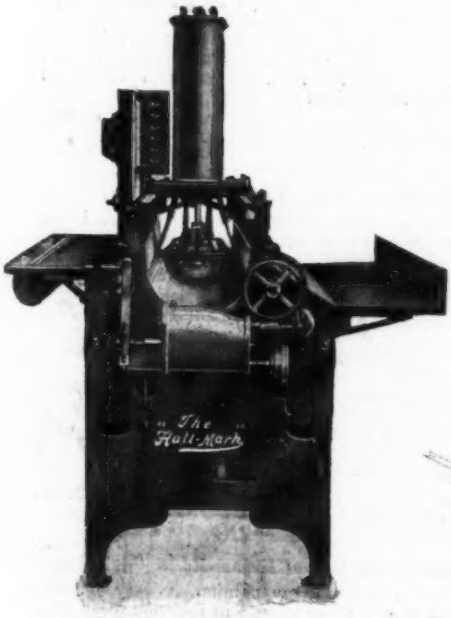


Fig. 1.—The "Hall-Mark" Copier.

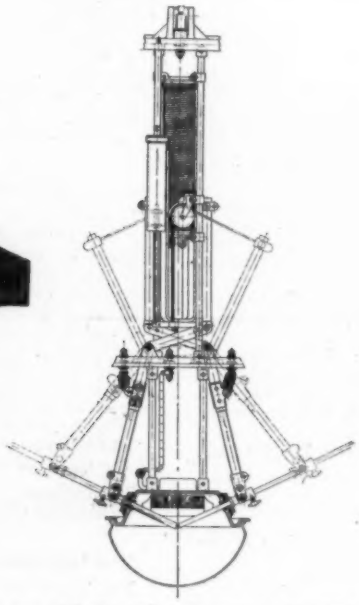


Fig. 2.—The Hall-Thorkelin Arc Lamp.

The "Vincent" Fuseboard.

The Vincent Switchgear Manufacturing Co., Balsall Heath, Birmingham, is manufacturing a hinged fuseboard. This fuseboard (fig. 3) is made up of the well-known "Vincent" fuse element, of the Home Office pattern, having all live parts well shielded with best English porcelain. These elements are mounted upon an angle-iron frame, which is fitted by means of a double hinge to the iron case, and can be easily swung out by the removal of one screw. This swinging out method is not new, but it is claimed that the fitting of a double hinge is new. This obviates the possibility of the fuse element near to the hinge becoming smashed in swinging. The angle-iron frame is well japanned, and not vulnerable to climatic conditions. These boards are at present made with from 2 to 12 ways, double and triple-pole, from 15 to 100 A per way, also with "pull and push" type switches. The London agents for this apparatus are the Enterprise Manufacturing Co., Ltd., and others are located in various parts of the country.

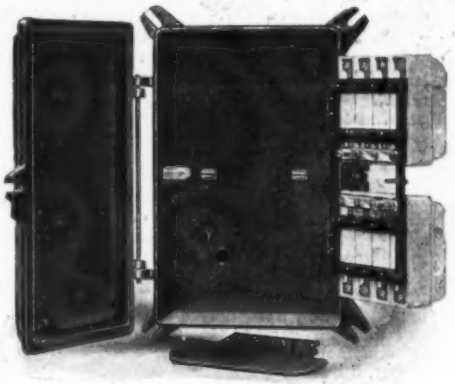


Fig. 3.—The "Vincent" Fuseboard.

A New Lamp Guard.

In a new lamp guard recently patented by Mr. Robert Emerson, "Glenmay," West Crescent, Darlington, the usual method of fixing is not employed. As will be seen from fig. 4, the guard is attached to the lamp itself. This arrangement, apart from the convenience of placing the lamp in, or removing it from, the holder, acts as a protection for the lamp at all times. The construction of the guard is amply illustrated in fig. 4. Any size of lamp can be provided for.

Fig. 4.—A New Lamp Guard.

The Blackburn Electric Locomotive.—Correction.—With reference to our note on page 705 of our November 25th issue on the above subject, in which it is stated that the locomotive derives its energy from a "Chloride Battery" we are informed that the accumulators are of the "Exide-Ironclad" type, specially designed by the Chloride Electric Storage Co., Ltd., for locomotive work.

CORRESPONDENCE.

Letters received by us after 5 p.m. on TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

A Disputed Meter Reading.

In October, 1919, I had my house wired for electric light; the wiring, on completion, was tested and passed as correct, and the Corporation fixed the meter.

The following are the readings of energy consumed per quarter:—

	Quarter ending March.	Quarter ending June.	Quarter ending Sept.	Quarter ending Dec.
1920	65	28	32	85
1921	71	90	30	—

The energy consumed was only used for lighting purposes. I have never had any electrical appliances in the house.

Obviously there was something wrong about the 90 units registered by dial on the meter for the quarter ending June, 1921.

I complained that the meter was wrong to the Corporation, and they undertook to test it, on my signing a form, in which I was to pay the cost if the meter was found correct; if it was wrong, they bore the cost of testing. The Corporation took the meter out and fixed a new one on July 29th, 1921. The result of their test is as follows; it was carried out on a "Ferranti" d.c. meter, 5 amperes, 220 volts, constant 13.44, starting current, 0.1 ampere:—

Three test loads.		Meter readings.		Test meter.
1 ampere	start	0430·843		0127·640
	finish	0431·834	·9% slow	0128·640
2·5 amperes	start	0431·843		0128·650
	finish	0432·828	1·5% slow	0129·650
5 amperes	start	0432·837		0129·660
	finish	0433·810	2·7% slow	0130·660
Total ...		...	5·1% ÷ 3 = 1·7% slow	

I next looked for an earth, getting the firm that did the wiring to test it; the result was: positive to earth 30 megohms; negative to earth 35 megohms.

Our downstairs lamps are 60-W Osram; never more than three lamps are on constantly after dark, *i.e.*, two in the sitting room and one in the kitchen, and during meals two in the dining room, but then the two in the sitting room are out. The bedroom lamps are 40-W Osram. No lights are left on except in occupied rooms downstairs; in bedrooms only whilst going to bed. Only two bedrooms are constantly in use. No hall or landing light is left on. During the quarter ending June, 1921, there was no illness in the house, and on some nights we went to bed by daylight; yet for the quarter of 92 days, the meter recorded 90 units used.

The Corporation are very nice and polite about it, as most Corporations are, taking their stand behind an Act of Parliament, which states "that if any difference of opinion as to quantity of current consumed arises, the meter shall be tested, and if found correct, the figures as given by the meter shall be taken as final." On this they press me for the charge for testing the meter and the cost of the 90 units.

Can any reader of the ELECTRICAL REVIEW throw light on the cause of the meter's jumping about 62 units, and then when tested being fairly correct?

Is it possible that the error did not occur all at once; also that the test (which was over 3 periods, at various loads as given above) did not cover the faulty spot in the mechanism of the meter? Any information on the above will be greatly appreciated by

Perplexed.

December 3rd, 1921.

Village Electricity Supply.

I should be greatly obliged if, through the medium of the REVIEW, some one would suggest the best means of protecting two d.c. generators (230 volts) both supplying the same busbars.

Briefly, the situation is this: the village in question has hitherto been supplied from one generator (compound wound) driven by a water turbine of 15 b.h.p., controlled by an oil pressure governor. No accumulators are used.

The plant is loaded to its utmost capacity, and it is proposed to augment the supply by using an old type over-shot water-wheel of about 7 b.h.p., some 1,000 yd. distant from the plant at present in use. The suggestion is to yoke a generator to the water-wheel and connect up to the original turbine house switchboard by overhead mains.

The water-wheel is not automatically controlled. It is to be brought into commission each night, when the load has about reached the limit of the turbine plant, and cut out again later in the evening when the load has decreased within the power of the turbine. It is expected that when the two prime movers are linked together (through the generators) the turbine will do the controlling; seeing that the water-wheel has no automatic control gear its load will, therefore, remain constant.

What would be the best protection for the generators in case either of the prime movers or generators should fail to function when at work? And also, when cutting in with the water-wheel plant, when the turbine plant is in need of assistance?

Water-Wheel.

December 3rd, 1921.

The Durability of Lead-covered Wiring.

For over 15 years I have often advised the use of lead-covered wires for certain work, and neither my clients nor myself have ever had cause to regret this advice; but after following the controversy in your columns, it would appear that everybody has not had the same happy experience. Might I, therefore, suggest that you publish a table giving the numbers of those who have written "for" and "against," and the branch of the business to which they belong? Those such as "A Layman" could go under as indicating the value of their opinion.

Haydn T. Harrison.

London, S.W.
December 3rd, 1921.

Repairing A.C. Motors.

I am obliged to "Tanner" for his letter on the above subject in your issue of November 25th, 1921, the more so as I gather from it that, while he has not met with similar trouble, he has been good enough to think the problem out. My letter was written rather hastily, and possibly I did not make it plain that the stator stampings were meant.

Provided that the motor is of the slip-ring type, and that a suitable supply is available, "Tanner's" method is worth trying, and I shall certainly do so should the opportunity occur.

The views of four leading repairers may be of interest:—

A considered that there was no workshop method of determining iron losses, and judged each case by its appearance.

B had never come across the trouble.

C was of the opinion that a.c. motors in which the stator stampings had been rubbed usually ran hotter after a re-wind. He added (and the writer cordially agrees with him) that people who never dream of using a thermometer will, after a repair, take the temperature as often as that of a fever patient.

D thought much the same as A, and mentioned that whenever it could be done, he had found that an extra turn per coil, when re-winding, was helpful.

Although very few people appear to have met this trouble, it is likely to become more common in the future, as in the present-day a.c. motor the iron, copper, and air gap are often cut as fine as possible.

Jaques.

London,
December 3rd, 1921.

One Solution of the Frequency Problem.

In outlining an alternative scheme to Mr. Sutton's interesting idea for the provision of different frequencies, Mr. Dorey appears to have overlooked the principal feature.

In Mr. Dorey's arrangement, employing a standard turbine, he would have difficulty in obtaining from two machines coupled in tandem on its shaft, periodicities of, say, 50 and 60; and incidentally, assuming a speed of 3,000 r.p.m., he would not get satisfactory results from a d.c. generator, should this be required.

With Mr. Sutton's idea, however, the fact that two different speeds can be obtained with the Ljungström turbine makes it possible to get these frequencies, and perhaps it is in cases where the periodicities are such that a common speed is out of the question that Mr. Sutton makes his claims.

A. L. Firth.

Birmingham,
December 6th, 1921.

The Installation and Use of Electricity in Coal Mines.

Mr. Travis has raised, in my opinion, a very important matter, and one that is as important in its application to any industrial installation as it is to mining service. The question of installing sufficiently large oil switches, I know from experience, is one that appears to be overlooked by many consumers connected to large generating stations.

The policy mentioned in Mr. Travis's letter of taking the risk of a switch exploding in order to save initial capital outlay is, I should say, usually very risky, and certainly not in harmony with our present-day "Safety First" cry.

It should be the policy of all consumers connected to large capacity mains to carefully investigate the conditions under which their plant will operate, and obtain, if necessary, advice on the question of proper and adequate switchgear for their service.

R. T. Norton.

Birmingham.
December 6th, 1921.

[Mr. Travis writes to point out that his initials are T. G., not "F. G.," as printed on p. 746.—EDS., ELEC. REV.]

BUSINESS NOTES.

The "Electrical Review" issue for December 23rd.—The attention of advertisers and readers is directed to an announcement appearing in our advertising pages to-day respecting the dates for sending in "copy" for our issues of December 23rd and 30th. Will correspondents and other contributors take note that for the issue of December 23rd all editorial matter for publication must reach us a day earlier in the week than usual?

Bankruptcy Proceedings.—Thomas Driffield Waring, 55, Walmgate, York, electrical engineer.—The first meeting of the creditors was held on November 29th at the Official Receiver's Offices, Duncombe Place, York. The ranking liabilities were returned at £52, and there was a deficiency of £24. Debtor attributed his failure to bad trade and lack of capital. It appeared that he started his present business two years ago with £10 capital, having previously been in business at Waterloo Place for two years. When he went there he had no capital, and the business was not successful. The matter was left in the hands of the Official Receiver as trustee.

J. Glynn Williams, electrical engineer, 4, Blaennant Street, Duffryn, Cymmer, Port Talbot.—Receiving order made November 30th on debtor's own petition.

T. Hyde, electrician, 180, London Road, Croydon.—Last day for proofs for dividend December 19th. Trustee: T. Gourlay, 29, Russell Square, W.C.1.

Company Liquidations.—W. G. C. Hayward & Co., Ltd.—Winding up voluntarily. Liquidator: Mr. E. H. Hawkins, 4, Charterhouse Square, E.C. Particulars of claims must be sent to the liquidator by December 30th.

The Premier Accumulator Co., Ltd., Cattle Market Road, Northampton.—This company is winding up voluntarily for the purposes of reconstruction to cope with the necessary increase of business. The name of the new company will be the Premier Accumulator Co. (1921), Ltd., and the business will be carried on as usual under the same management. Liquidator: Mr. A. L. Airs, 2a, Sheep Street, Northampton. A meeting of creditors is called for December 14th.

Aqua Electric Co., Ltd.—Winding up voluntarily. Liquidator: Mr. R. Manners, 14, Hanover Square, W., who is authorised to consent to the registration of a new company to be named the "Aqua Electric Co., Ltd." Meeting of creditors, December 16th, at 85, Gracechurch Street, E.C.

Railless Electric Traction Co., Ltd., and R. E. T. Construction Co., Ltd.—Meetings of members, January 3rd, at 28, King Street, Cheapside, E.C., to hear an account of the winding-up from the liquidator, Mr. A. Page.

Allies Electric Lamp Repairing Co., Ltd.—A petition for winding-up has been presented to the High Court by Mr. L. Kessler, consulting mining engineer, of Oakwood, Bexley, Kent, and will be heard in London on December 13th.

Pritchett & Gold and Electrical Power Storage Co., Ltd.—With reference to the notice appearing in our last issue regarding the liquidator's final meeting of this company, our readers are, of course, aware that this old-established business, under its new title, Pritchett & Gold and E.P.S. Co., Ltd., is unaffected by the liquidation of the old company. The directors were advised that liquidation of the old company and formation of the new would be the best means of giving effect to certain necessary alterations, amongst which was the reduction of four classes of shares (set up as a result of absorption in recent years of the Electrical Power Storage Co. and Peto & Radford) to two classes.

Dissolutions of Partnership.—Moseley Installation Co., electrical engineers, 176, Alcester Road, Moseley, Birmingham.—Mr. D. A. Capewell and Mr. R. B. H. Gossage have dissolved partnership, Mr. Capewell retiring. Debts, &c., will be attended to by Mr. Gossage.

Chartern Manufacturing Co. and Lewis Eastwood & Co., art metal workers, transport contractors, and electricians, Stafford Street, Birmingham.—Messrs. L. Eastwood and G. A. Day and Lizzie Winchurch have dissolved partnership. Debts will be attended to by Mr. L. Eastwood and Lizzie Winchurch, who will continue the business.

Camfield Co., electrical engineers, 312, Deansgate, Manchester.—By an indenture dated November 25th between J. V. Gil and H. S. Harker, the goodwill of the business has been assigned to the latter, and he will attend to debts, &c.

Trade Announcements.—We understand that arrangements have now been concluded whereby Mr. L. M. Waterhouse, M.I.E.E., A.M.I.C.E., resigns his directorship and retires from the board of Messrs. Tube Investments, Ltd., Simplex Conduits, Ltd., and Credenda Conduits Co., Ltd., manufacturers of electrical conduits and fittings, art fittings and signs, and electrical heating and cooking apparatus. Mr. Waterhouse is starting in business at 19, Rathbone Place, W., and is specialising in the sale of electric heating and cooking apparatus generally, which will include the well-known "Creda" make, and art fittings and signs of "Simplex" manufacture.

The Jackson Electric Stove Co., Ltd., has appointed as its agent for Ulster Mr. Robert Garmany, of 1, Union Street, Belfast, where a range of samples and small stocks will be held.

Messrs. Trevelyan & Co. have opened a new London office at 40, Newman Street, Oxford Street, W.1, where they are carrying stocks of "Ireva" lampholders, switches, &c. Mr. Emlyn Phillips is their new representative. Telegraph address: "Emlynhl Ox. London." Telephone No.: Museum 1352.

Mr. J. S. Child, until recently joint sales manager to the Edison Swan Electric Co., Ltd., has opened temporary offices at 185, Wardour Street, London, W.1. Telephone No.: Regent 6167. Telegraphic address: "Jayesscee Ox. London." He desires to receive manufacturers' catalogues.

The Westminster Tool & Electric Co., of Westool Works, Putney, S.W.15, states that it is now able to supply its Westool electric portable drills in sizes up to ¾ in. holes, fitted with Universal motors, rendering them suitable for use either on direct- or single-phase alternating-current circuits.

On Monday next, Messrs. Johnson & Phillips, Ltd., of Charlton, are opening a branch office and warehouse in Liverpool at 57, The Albany, Old Hall Street. Stocks of their cables, flexibles, and fittings will be held there. We understand that the demand for these products has increased so greatly in Lancashire during the past three years that the business cannot any longer be handled adequately from their Manchester branch.

Catalogues and Lists.—British Insulated & Helsby Cables, Ltd., Prescot, Lancashire.—Illustrated and priced pamphlet (H.97), fully describing the Helsby twin wiring system, which employs rubber-insulated metallic-sheathed cable.

The Edison Swan Electric Co., Ltd., Ponder's End, Middlesex.—A catalogue giving prices and illustrations (many coloured) of silk shades for various types of lighting fittings.

The A. & A. Electrical Co., Ltd., 13, Farringdon Road, E.C.1.—A price list giving full particulars of 2- and 3-phase motors, ranging from 0.7 to 150 h.p.

Electric Fires, Ltd., King Street, Norwich.—An illustrated and priced booklet of electric fires, garage heaters, grills, boiling rings, &c.

Messrs. L. G. Hawkins & Co., 116, Charing Cross Road, W.C.2.—Two leaflets describing "Universal" toasters, kettles, grills, and other heating and cooking appliances.

Messrs. Walker, Crosweller & Co., "Dane's Inn House," 265, Strand, W.C.2.—A pamphlet illustrating and describing "Arkon" full-scale draught and pressure gauges.

The Runbaken Magneto Co., Ltd., Cheetwood Lane, Derby Street, Manchester.—Five illustrated leaflets dealing respectively with a petrol gauge; an automobile headlight dimmer; a spark indicator and amplifier; a double sparking plug; and an aluminium piston.

Ateliers de Constructions Electriques de Charleroi, 56, Victoria Street, S.W.1.—List No. 1, giving illustrations, descriptions, and details of working of the firm's centrifugal pumps. An aerial photograph of the Charleroi works is included.

The Dowsing Radiant Heat Co., Ltd., 91 and 93, Baker Street, W.1.—A very complete catalogue of electric cooking and heating devices, giving illustrations, descriptions, and prices.

The Enterprise Manufacturing Co., Gun Street Electrical Works, Bishopsgate, E.1—A list of current prices of electrical goods and apparatus, including switches, lampholders, ceiling roses, plugs, kettles, irons, toasters, &c.

Messrs. R. O'Brien & Co., 66, Mosley Street, Manchester.—An illustrated and priced catalogue of "Luna" decorative glassware for lighting purposes.

Messrs. Gent & Co., Ltd., 25, Victoria Street, S.W.1.—Folder 57, giving illustrations and particulars of electric motor sirens.

Messrs. Williams & Williams, Ltd., Sardinia House, Kingsway, W.C.2.—Two pamphlets illustrating "Reliance" standard fittings, including metal window frames for various kinds of buildings.

The English Electric Co., Ltd., Queen's House, Kingsway, W.C.2.—A leaflet giving views of the new Blackburn power station, for which the company supplied plant. Views are also given of electrical machinery in use for various purposes.

The Jeary Electrical Co., Ltd., 8, Lambeth Hill, Queen Victoria Street, E.C.4.—Two priced leaflets dealing with electric bells, bowl fires, torches, &c.

Private Meeting.—H. Hunt (trading as H. Hunt & Co.), 6, Cooper Street, Bury, Lancs., electrical engineer.—A meeting of the creditors in this matter was held on November 29th, when it was reported that the liabilities amounted to £496, all due to unsecured creditors, while the assets were estimated at £203. The debtor was formerly in partnership, but it was understood that his partner had now gone away. The debtor was anxious to continue the business, and was of the opinion that if he were allowed to do this, the business would show a

fair profit. The meeting was eventually adjourned with a view to the debtor bringing forward the offer of composition suitably guaranteed. The following are creditors:—

	£		£
General Electric Co.	40	Falk, Stadelmann & Co. ...	17
Power & Lighting Supplies ...	27	C. F. Bury & Co.	37
J. C. White	24	Aero & Motors, Ltd.	18
Park Electric Co.	92	T. Harwood	186
W. D. Rodda & Co.	26		

A French Rumour.—A rumour having been circulated that the French Thomson-Houston Co. proposes to absorb the undertaking of the Compagnie Générale Electrique of Nancy, it is stated on behalf of the former that no discussions are proceeding on the matter between the two companies at present.

"Ageekay London."—We have been called by other names at many stages of our career. But "What's in a name?" when "a rose by any other name would smell as sweet"? The Electrical Review is stolidly indifferent to the alteration of its final letter, but what happened to those who bear the honoured names of Alabaster and Gatehouse, and to all others at "4, Lubjapy Hill," when a Belgian letter arrived addressed as under, may, as the budding journalist would say, be "better imagined than described":—

Electrical Revieu
H. Alababper, Gapehofe Cie
4, Lubjapy Hill
London, E.C.

Local Electrical, &c., Exhibition.—At the West of England Health and Home Exhibition, being held in Plymouth from December 7th to 17th, The Falkirk Iron Co., Ltd., is displaying a large selection of cooking and heating apparatus. A large part of the company's stand at the recent Public Works Exhibition, which included a large electric double-oven range and a cooker similar to those supplied to the Glasgow Corporation, has been transferred to Plymouth.

The Decimal Association.—The annual general meeting of the Decimal Association was held on November 30th, when the chairman (Mr. Theodore McKenna) gave a *résumé* of the principal events of the past year, specially drawing attention to the action of the Ministry of Agriculture in printing metric scales on all small-scale maps, and the decision of Japan to put the metric system into force next year. After the election of the executive committee, Mr. E. C. Barton put forward his proposals for a step-by-step policy in dealing with weights and measures, and the following resolution was passed: "That this association, while adhering to the policy of adopting the metric system of weights and measures, recognises that its object can best be obtained in steps, and that the first step should be the dealing with weights."

Mr. Allcock referred to his proposal for dealing with the coinage by a method which would have the advantage of retaining the present values of all the coins from 1s. upwards, and a resolution was passed approving of the scheme proposed by which the present values of the £ and the shilling would be maintained, but the shilling would be divided into 10 pence instead of 12, thus increasing the token values of the existing copper coins (pence, half-pence and farthings) by 20 per cent.

British Industries Fair (Birmingham).—We understand that, notwithstanding the present adverse conditions, the interest which is being shown in the British Industries Fair (Birmingham), which will be held at Castle Bromwich from February 27th to March 10th, 1922, is very gratifying to the Fair authorities. Manufacturers would do well to avoid the temptation to refrain from exhibiting at a show of this nature because times are bad. The credit facilities afforded by the Government under its recent legislation should be of great value to oversea buyers at the British Industries Fair. A bureau will be established at the Fair by the Export Credit Department of the Department of Overseas Trade. Thus oversea buyers can, under one roof, inspect the best of all classes of British goods, and if agreements to purchase are likely to be made, the exhibitors can arrange liberal terms of credit in view of the assistance provided for under the Trade Facilities Act, the sole object of which is to facilitate the resumption of the ordinary means whereby traders and others can obtain facilities from their bankers to enable them to finance their export trade.

Continental Glow Lamp Interests.—A Vienna newspaper published a report last week that all the shares in the Westinghouse Metal Filament & Glow Lamp Co., of Vienna, had passed into possession of the Osram Co. and the Philips Glow Lamp Co. It appears, however, that these companies are only indirectly interested in the Vienna company, through their shareholdings in the Swiss Aarau Glow Lamp Works, Co., which now holds a large participation in the Vienna company.

Trunk Telephone Cables.—Within the last few months British Insulated & Helsby Cables, Ltd., have supplied, laid and jointed 320 miles of multiple twin telephone cable for the British Post Office, and at the present time they have in hand 150 miles of the same type of trunk cable. The company has recently completed the supply, laying, and jointing of a multiple twin telephone cable between Luxembourg and Diekirch—a distance of 35 kilometres.

Magneto Manufacture.—The "Combination" Metallic Packing Co. (1921), Ltd., of Hillgate, Gateshead-on-Tyne, has acquired the sole licence for the manufacture of the "Combination" super-magneto, which has been developed by Mr. E. Harrison, of Benwell, Newcastle-on-Tyne. The machine generates, from one armature, both direct and alternating currents, used respectively for lighting and ignition.

Employment in Sweden.—According to a report issued by the Swedish Economic Department, the number of electrical manufacturing works in operation has declined from 30 to 28 between September 1920 and October 1st, 1921, while the number of workmen employed has receded from 7,480 to 4,236 in the same period. The competition of Switzerland is being experienced specially in steam turbines, and lately Denmark has appeared as a rival to Sweden in electrical machinery and cables.

Calendars and Almanacs.—The first almanac for 1922 to reach us is "The Abdulla," received from Messrs. Abdulla & Co., Ltd., 173, New Bond Street, London, W.1, the cigarette people who, as usual, offer 10,000 copies for sale at 1s. 6d. each for the benefit of the British Red Cross Society. It is a handsome production, with twelve monthly sheets adorned by coloured illustrations by special artists.

New B.T.H. Showrooms.—We reproduce herewith a photograph of one of the showrooms opened at Manchester

A B.T.H. Showroom, Manchester.

recently by the British Thomson-Houston Co., Ltd. Every class of lighting is represented, and contractors and dealers are invited to call or send their clients to the new showrooms.

Book Notices.—"Patents and Chemical Research," by H. E. Potts. Pp. ix+198. Liverpool: University Press of Liverpool. Price 8s. 6d. net.

"The *Bulletin* of the Hydro-electric Power Commission of Ontario." Vol. VIII, No. 4, July-August, 1921. Toronto: The Commission.—The articles in this number include one on the power-factor problem, a comparison of rates charged for electricity by municipalities in the province; and "Merchandise Possibilities in Hydro Municipalities."

"Applied Calculus," by F. F. P. Bisacre. Pp. xiv+446. Illustrated. London: Blackie & Son, Ltd. Price 10s. 6d. net.

"Directive Wireless Telegraphy," by L. H. Walter. Pp. xii+124, figs. 57. London: Sir I. Pitman & Sons, Ltd. Price 2s. 6d. net.

"*Bulletin* of the Cleveland Technical Institute." Vol. I, No. 2, November, 1921. Middlesbrough: The Institute.—These are abstracts of recent technical and scientific articles, printed on one side of the paper only for filing purposes.

Technologic Paper No. 202 of the U.S. Bureau of Standards, "Results of a Survey of Elevator Interlocks and an Analysis of Elevator Accident Statistics" (30 pp.). Washington: Government Printing Office. Price 5 cents.

"The Framework of Wireless Telegraphy," by R. C. Calletti di Cadilhac. Pp. vi+48. London: Crosby Lockwood & Son. Price 3s. 6d. net.

The Alby United Carbide Co.—A *Reuter* dispatch from Christiana says that M. Blakstad, director-general of A/S Tyssefaldene, who has arrived there from London, states that the Tysse Falls Co. will take possession of the Alby factories at Odda, the Alby United Co. owing the Tysse Falls concern a large sum of money. The factories will be put up for public auction in January, and the Tysse Falls Co., together with the English syndicate to which M. Blakstad has transferred his interests, intends to re-start the factories within six months for the production of ammonium sulphate. With regard to the statement that the Tysse Power Co. will take possession of the factories at Odda and put them up for sale, the directors of the Alby Co. inform Reuter's Agency that,

following the purchase by an English syndicate from M. Blakstad of the control of the Tysse Power Co., they were approached by Mr. A. E. Barton with proposals for the formation of an important company to develop the Claude process for the manufacture of sulphate of ammonia. These proposals involved the re-organisation of the Aiby Co., and the general terms were agreed verbally with Mr. Barton on November 8th, but difficulties have subsequently arisen in arranging finance, and Mr. Barton has, in consequence, withdrawn from the negotiations.

Electrical Progress in Argentina.—The port authorities at Buenos Aires lately called for tenders for the supply of about 20 electric cranes and motors. Over 10 firms tendered, and the estimated cost of the articles ordered exceeds 800,000 pesos m./n. Whereas Argentina was formerly a leading market in South America for foreign-made electrical devices, several local factories have lately been established, and are fast providing domestic requirements, which is calculated to lessen importations of such goods very considerably. Many factories are now turning out dry batteries, carbon brushes, and insulated-conduit (Bergmann type). The manufacture of incandescent lamps has also been commenced, but so far the business has proved unsuccessful. In Argentina there are three well-established organisations devoted to engineering, of which two are purely electrical. These are the Instituto Sud. Americano de Electrotécnicos y Mecánicos, and the Asociación Argentina de Electrotécnicos. The members of the former are principally wiremen and station operators, and the institute, therefore, is in a good position to disseminate practical information where it will effect the most good.

The Asociación Argentina de Electrotécnicos is composed almost entirely of graduate engineers, who are in private practice, or in the employ of large companies, or of the Argentine Government. Regular meetings are held, at which papers are read upon subjects of current interest, while frequent visits of inspection to local electrical works are arranged. A French engineering company has been granted a concession by the Argentine Government for the erection and operation of a radio station for direct communication with France. The concession is for a period of 30 years, and the company is allowed three years for preparation before commercial service is demanded. By the terms of the agreement the company's wireless messages will be forwarded over the State telegraph lines, and the rates of messages will be fixed by the National Government.—*Reuter's Trade Service* (Buenos Aires).

The Future of India.—The great and far-reaching changes which are taking place in the Constitution of India—the most important market for United Kingdom engineering products—will re-act on her commercial relationships with the United Kingdom and other countries to such an extent that a volume which aims at presenting within its covers a complete *résumé* of the facts of the position and the various factors which may modify that position in the future appears at an opportune moment. This is the object of His Majesty's Senior Trade Commissioner in India and Ceylon in his "General Review of the Conditions and Prospects of British Trade in India during the Fiscal Years 1919-20 and 1920-21." (H.M. Stationery Office, 5s. 5d. post free), issued by the Department of Overseas Trade. The review, which is revised to October last, is of particular interest to the engineering industry, if only for the fact that it contains a full account of the position in regard to the purchase of Indian Government supplies and the detailed proposals for the new Indian Stores Department. There has been a growing feeling for many years among all sections of Indian opinion, and particularly among Indian industrialists, that the Government should adopt a more liberal policy for the purchase of such articles as can be manufactured in the country. Under this influence the Stores Rules were modified in 1909 and 1913, but the greatest effect came as a result of war conditions. Under the Amended Stores Rules, drawn up by the Government of India (they are not yet in final form, however) plant and machinery may be purchased from branches established in India of British manufacturing firms borne on the list of the India Stores Department, London. Thus the many British engineering firms who have maintained branches in India for years, staffed with qualified engineers and commercial men, and who, although remarkably successful in the industrial field, have hitherto been handicapped in quoting for Government orders under the Old Stores Rules, seem likely at last to come into their own. With this subject is to be studied the new status acquired by the Provincial Governments under the Amendments to the Government of India Act (usually known as the Reforms Scheme). These amendments, which became law at the end of 1919, and are now being generally worked, place the development of provincial industries under popular control. Mr. Ainscough considers the personnel and organisation of the various provincial departments of industry. He provides a list of directors of industry, the executive head of the provincial department and keystone to the whole scheme and calls the attention of agents, representatives and travellers of British firms engaged in the manufacture of industrial plant and machinery, to the desirability of establishing friendly relations with them, feeling sure that they will appreciate such attentions. Besides statistical records, there are many other sections of special interest in this review, such as the development of agriculture as it affects the supplier of plant, and the development of the hydro-electric power resources of India. The Trade Commissioner states in the latter connection that the position of United Kingdom firms is changed for the better since the Preliminary Report of the Hydro-electric Survey, published in 1919, recorded that British manufacturers of pipes, turbines, generators and switchgear were content to take small orders only, leaving the large ones to countries specialising in water-power plant.

For Sale.—Dundee Corporation Electricity Department has surplus generating plant for disposal, including two 2,000-kW turbo-alternators, several generating sets, boilers, stokers, pumps, &c.

By Direction of the Disposal Board, Mr. A. H. Davis will sell by auction on December 13th and following days, at the National Filling Factory, Park Royal, N.W., surplus electrical plant and machinery, &c. (See our advertisement pages to-day.)

Copper and Lead Prices.—Messrs. F. Smith & Co. report, December 7th: Copper (electrolytic) bars, £76 10s. (5s. dec.); ditto sheets, no change; ditto wire rods, £92 10s. (5s. dec.); ditto h.c. wire, no change; selicium bronze wire, no change.

Messrs. James & Shakespeare report, December 7th: Copper bars (best selected), sheet and rod, no change; English pig lead, £26 15s. (5s. decrease on last week's prices).

Theatre Lighting.—The Margate Hippodrome has recently been practically re-constructed to serve the dual purpose of kinema and theatre. An entirely new lighting scheme was installed of which we are able to give some details by the courtesy of Mr. W. C. C. Hawtayne, M.I.E.E., the consulting engineer. The auditorium is illuminated by five large ceiling fittings. Of these, the centre fitting is 6 feet in diameter, the remainder being 3 feet in diameter. These fittings, which are shown in the accompanying illustration, were manufactured by the General Electric Co., Ltd., to the consulting engineer's plans, to replace the old type pendants with their clumsy and unsafe lowering gear. The wires are tubed right up to the lampholders, and every lamp is easily replaceable from above. The red and white lights are on separate circuits, kept well apart, and efficient and well graduated dimming arrangements are provided. Hinged panels in the fittings allow them to be cleaned both inside and outside from above without difficulty.

The Auditorium, Margate Hippodrome.

Cause of Capital Increases in Germany.—Contrary to what is generally thought in England, says a correspondent, the depreciation of the currency and not overbounding prosperity, is the cause of the great increases in the capital of German electrical companies recently. This is shown by figures published by the *Elektrotchnische Zeitung*. In 1914 only seven electrical manufacturing firms, two share companies, and five limited companies raised their capital, the first by 12,000,000 marks, and the last by 754,000 marks; in the following five years there were twelve cases of increases to a total of 6,120 million marks. In 1920, however, there were 43 share companies with 709,625 million marks, and 37 limited companies with 4,508 million marks. Account should here be taken of the fact that the creditor postings in the balances of the companies had greatly increased in the case perhaps of the majority of the share capitals. Dividends had, too, been increased in the major number, if not in every case; how far this had regard to the depreciation of the currency remains to be seen; but when it is remembered that the greater part of the capital was subscribed in gold, while the dividends were paid in paper, it will be recognised that these favourable figures of capital increases assume quite another appearance. The effects of the prevalent inflation is only further enforced by a recital of the higher disbursements made under the headings of salaries and wages. In the Siemenswerke balance sheet, for instance, for 1919-20, they rose from 236 million to 496 million marks, as compared with 70 million marks in the last peace year.

The Rating of Electricity Undertakings and Factories.—Discussing the subject of "Rating and the War," at a meeting of the Auctioneers' and Estate Agents' Institute, held in London, Mr. P. Michael Faraday said that in the case of electric light companies and similar companies, the cost of coal and the additional cost of labour were factors which had risen altogether out of proportion to the increased price obtainable for the service. Hence there were deficits, and the companies, in order to make both ends meet, were seeking to reduce their local ratings, and rightly, as the law now stood. The local authorities needed the money to carry on the services they were compelled to provide in the interest of the community, and it seemed to him that the solution was to be found in a policy under which the spending authorities must spend as little as possible commensurate with providing essential services, in order that the ratepayers might not have to pay more than they could possibly afford. Otherwise, we reached the breaking point, and his experience showed him that a large number of companies could not possibly pay the rates they did in 1914, as their profits would not permit of such a contribution. There was, perhaps, no class of property more difficult to deal with than factories. Since the war the burden had been anything but light, and it was increasing, and the old-time amiability of the owner-occupier of an industrial concern had given place to a desire for something more correctly interpreting the law as it was written than the old assumption that a business man stood ready to pay 5 per cent. in perpetuity upon capital invested over a long period of years. The owner-occupier was beginning to understand what the words "beneficial occupation" meant, and was inclined to point out that a man might sink and lose money in the pursuit of a certain trade, but that to make him pay 5 per cent. per annum on the money he had lost savoured of "rubbing it in," and did not properly interpret the law of rating as the owner-occupier thought it should be and hoped it was. If the conditions under which each several industry was working were not carefully considered and their effect on the industry properly appraised, it was impossible to estimate correctly the change that had taken place in the value of the occupation of a given works to the tenant, whether it be up or down, by reason of the war. In a similar manner new factories, workshops, and new industries were created during the war to such an extent that the relative position of former factories had been completely changed. The capacity for production in many lines of trade had enormously increased, and this sudden introduction of such a large proportion of productive capacity laid out on modern lines must have a very serious influence on the beneficial occupation to be derived from the new subjects themselves, and a far greater influence on those of an earlier date. It was a truism that value was measured by the laws of supply and demand, and it should be a rating truism to say that the value of beneficial occupation could only be fairly estimated by a thorough and intelligent analysis of any changes that had taken place to affect the demand for a particular class of hereditament, due consideration being given, of course, to the question as to whether the change in the demand for the class of hereditament was of a temporary or a permanent nature. As a result of the conditions created by the war we must do one of two things—change the law of rating as it stood to-day or apply our minds to understand thoroughly the effect of the new conditions. Only by so doing could we avoid creating grave injustices and inequalities which must inevitably lead to expensive and unproductive litigation. The time-honoured rule-of-thumb methods must give place to considered thought upon the new problems, and we must bear very strongly in mind that this country earned its living by its industries, and though they might seem a good target to shoot at when more money was needed for local rates, the killing of the goose that laid the golden eggs had never been lauded by the thinking man. It seemed very clear to him that one of the greatest problems in rating that had arisen directly from the war was how industrial undertakings were to be treated.

Patent Applications.—Application has been made by Curt Stille for the restoration of Patent No. 9 061, of 1913, for "Improvements in optical receivers for facsimile telegraphs."

Henri Francois Etienne, Sylvain, Dusseris, has made application for the restoration of Patent No. 29,210, of 1911, for "Improvements in means for converting a continuous rotary movement into a step-by-step rotary movement."

Application has been made by Paul Gerhardt Tismet for restoration of Patent No. 9,441, of 1914, for "Improvements in and connected with fuel-injection devices for internal-combustion engines."

Correction.—We regret to find that in our reprint of the report prepared by the committee of the proposed N.E. Coast Trading Association credit was given to the wrong gentlemen. The circumstances of the case are such that we cannot conscientiously blame the printer (in accordance with long-established custom), or we would do so. It would not be uncomplimentary to say that the written signatures on the report were not in the clearest copper-plate handwriting that we have seen, for has it not been characteristic of some of our most noted men of science, authors, financiers, and others, that their autographs were conspicuous for originality of form? Our tender heart, therefore, inclines us to exonerate the printer for having rendered A. Albrecht (chairman) as C. H. Merz, and Samuel I. Ellis (hon. secretary) as Samuel C. Davis.

Russian Industrial Property.—The following information has been received by the Department of Overseas Trade from the British Agent at Moscow. The matter was briefly referred to here last week. According to a decree dated May 17th, 1921, issued by the Russian Soviet Government, and subsequent rulings of the Supreme Council of National Economy, all undertakings in Russia which were not *de facto* nationalised prior to that date are to be considered as denationalised and the owners are immediately to be re-instated. In bringing the above information to the notice of the Department, the British Agent points out that the term "*de facto* nationalised" is considered to include all undertakings where a specific resolution of nationalisation has been passed by the Central Department or District Council of National Economy concerned, and where any of the following events has occurred:—

1. The undertaking was actually taken over, keys being taken from the owner and an inventory made.
2. A works manager was appointed and a plan of production laid down.
3. The expenses of running or protecting the undertaking were included in the estimates of the corresponding Central Department or District Council of National Economy.
4. The process of taking over started before May 17th, 1921, and the documents show that part of the property was actually taken over prior to that date.

In view of the possibility that certain British-owned undertakings may fall within the scope of the decree of May 17th, any British firms or persons who have reason to believe that none of the conditions mentioned above would apply to their works, and that these in consequence may be regarded as not having been *de facto* nationalised up to May 17th, 1921, are invited to communicate the facts to the Department of Overseas Trade in order that the necessary inquiries may be made through the British Agent.

United States Exports of Electrical Goods.—The Department of Commerce reports that the exports of electrical goods during September were valued at $4,878,883, as compared with $7,308,093 in the corresponding month of 1920. The total exports for the nine months ended September 30th, 1921, were valued at $81,349,928, an increase of $13,678,947 over the figures for the same period in 1920. Details of exports in September 1921, compared with the corresponding month in 1920, are as follows:—

Electric Machinery and Appliances (Except Locomotives).

	Sept., 1920.	Sept., 1921.
Batteries	$607,936	$271,232
Carbons	119,233	42,402
Dynamos and generators	461,673	855,419
Fans	70,489	21,129
Heating and cooking apparatus	95,986	95,699
Insulated wire and cables	635,641	270,145
Interior wiring supplies, including fixtures	241,042	55,761
Arc lamps	$1,053	$455
Incandescent, carbon filament	4,402	2,448
Incandescent, metal filament	244,047	76,187
Magnetos, spark plugs, &c.	271,177	66,509
Meters and measuring instruments	190,331	191,411
Motors	1,230,408	537,558
Rheostats and controllers	33,309	45,304
Switches and accessories	281,635	159,690
Telegraph apparatus, including wireless	38,093	65,563
Telephones	246,841	262,062
Transformers	208,493	353,033
All other	2,326,304	1,506,876
Total electrical machinery, &c.	7,308,093	4,878,883

Reuter's Trade Service (Washington).

New German Company.—Under the style of Bauunion G.m.b.H. Kommanditgeselischaft a new undertaking has been formed, with offices at Berlin and Munich, out of the electric railway department of the Siemens & Halske firm. The other parties in the new company are the Elektricitäts Aktien Gesellschaft, formerly Schuckert & Co., of Nurnberg, and the Berlin Siemens Schuckertwerke. The capital of the new company is 20,300,000 marks. Its scope of operations will comprise electric railways and water-power stations, and haven, river and armoured cement operations. The new company will not only carry out works for the parent firm, but also for third parties.

The Welsh National Exhibition.—Arrangements for the exhibition which is to be held at Cardiff from May to October next year, are well in hand. A substantial guarantee fund is being prepared and is being liberally supported. The work on the exhibition, on which a large number of men will necessarily be employed, is commencing forthwith under the direction of Sir Charles T. Ruthen, president of the Society of Architects, and it is anticipated that the exhibition will be ready for opening on May 1st.

Wages in the Iron and Steel Trades.—Under the sliding scale adopted by the Board of Conciliation and Arbitration for the manufactured iron and steel trades of the North of a further wage cut of 10 per cent. became operative last week, reducing the wages to 87½ per cent. above the standard. At the beginning of the year wages were 230 per cent. above the standard.—*The Times.*

Christmas Holidays.—The Midland Railway workshops at Derby, in which about 10,000 men are employed, will be closed for a full week for Christmas.—*The Times.*

Price Reduction.—With reference to the reduction in price of the Willys light and power set mentioned in our last issue, we are now informed that the change will take place not from December 1st, but from to-day, December 9th.

The Tokio Peace Exhibition.—The Tokio Peace Exhibition will be held from March 10th to July 31st, 1922. A complete pavilion will be set aside for British exhibits. The arrangements for the British exhibits are in the hands of a well-known firm of British engineers and contractors in Tokio, Messrs. Arthur Buckney & Co., with whom the Federation of British Industries is now co-operating in London. The Federation has secured stands in the British section for the display of catalogues, literature, &c. The foreign section is being well supported, particularly by American and German firms.—*Eastern Engineering.*

LIGHTING AND POWER NOTES.

Australia.—Western Australia.—The annual report of the Government Electricity Supply Undertaking shows a total revenue of £92,312. Working expenses amounted to £74,978, leaving a gross surplus of £17,334. After the payment of capital charges, there was a net loss of £3,310. In the previous year there was a net profit of £4,046.

Beckenham.—Loan.—The Council's engineer (Mr. J. E. Tapper, M.I.E.E.) states, with reference to the note which appeared under the above heading in our issue of November 25th, that the amount of £5,349 applied for was not in excess of the estimate of the cost of new plant, but the balance of the sum originally applied for but only partly sanctioned.

Birmingham.—New Power Station.—Progress has been made with the construction of the Corporation electric power station at Nechells, and the hope is entertained that the first section of the new installation will be brought into use early in the new year.

Blackpool.—Electricity Extension.—The Electricity and Tramways Committee has decided to apply for sanction for the extension of the mains outside the borough boundary into the rural district of Marton.

Brackley.—Electricity Supply.—The Town Council has under consideration a proposal for the installation of electric lighting in the town.

Bradford.—Water Power.—Arrangements are now complete for generating electricity by the water power provided at Angram, in higher Nidderdale, for driving the cranes and other contractors' plant engaged by the Bradford Corporation in the construction of the new Scar House reservoir, in the West Yorkshire highlands. The plant will also light the Angram model village. The installation was formally inaugurated on Wednesday last.

Canada.—Newfoundland.—The *Liverpool Daily Courier* recently reported an interview with Mr. H. D. Reid, who has been in this country to raise capital for a large hydro-electric scheme. He plans to use the Humber River falls to develop about 235,000 h.p. The power will be used principally for special industries, such as the production of paper and pulp, and possibly for dealing with aluminium and nitrates.

Carmarthen.—Fire.—A fire burned out the generating station early on the morning of the 2nd inst. The town is supplied with electricity by the Carmarthen Electric Light and Power Co. (the engineer being Mr. A. Preston, A.M.I.E.E.); some 900 consumers are connected to the overhead main, and the whole of the streets within the borough are lighted electrically. The generating plant consists of two suction gas engines, one horizontal and one vertical, two vertical Diesel oil sets, and a 750-Ah battery.

It is customary to shut down the generating plant at midnight, and leave the battery to meet the demand until the morning, and it appears that about half an hour after the last man had left fire broke out near one of the compressed-air containers, which seems to have burst under the heat pressure, and in bursting displaced two fuel oil tanks immediately above it, emptying their contents over the roof and the building generally. This was followed by the fire reaching a number of lubricating oil barrels, which assisted in feeding the flames until the whole of the engine room was one mass of flames and the roof fell in, entirely destroying the switchboard and at least three of the four generating sets.

The fire brigade arrived and, with the aid of the electrical staff, succeeded in saving the battery room intact; one of the Diesel sets, it is hoped, can be repaired in the course of a few days, and a partial supply resumed, but a great deal of temporary work must be done before this can be effected. The application of water to extinguish the fire assisted in the destruction of three of the generators, but one Diesel set escaped serious damage in a remarkable manner.

It is gratifying to note the enormous number of offers of assistance and sympathetic telegrams that Mr. Preston has received, and the company is fortunate in possessing the goodwill of the residents and the Corporation itself, so that every assistance is being rendered the company to help it through a very critical period.

Cheshunt.—Extension of Supply.—The North Metropolitan Electric Power Supply Co. has decided to extend the area for the supply of electricity to Cheshunt. Work is to be commenced at once, and the installation will probably be completed by January next.

Chesterfield.—Staff Wages.—The Corporation has notified the National Joint Board for the Electricity Supply Industry that unless a revised scale of salaries is put into operation before February 1st, it will withdraw from the Board.

China.—Hong-Kong.—The Hong-Kong Electric Co. is laying new cables in connection with the installation of a new distributing system throughout the city. Two new 5,000-kW generators are being added to the installation at North Point, bringing the capactity up to 13,000 kW. When this work is completed the station at Wanchai will be dispensed with and the present 100-V system will be gradually changed throughout the Colony to 200 V. It will take between two and three years to complete the transformation.—*Eastern Engineering.*

Continental.—France.—La Société d'Energie Electrique du Sud-Ouest is increasing its capital from 30,000,000 to 50,000,000 francs for the purpose of erecting the necessary high-pressure mains for the supply of electricity to the French wireless telegraph stations at Croix-d'Hins and Arcachon, and to meet the increasing demand for electricity for lighting and power purposes. The company, which was formed in 1906, supplies energy to the greater part of Bordeaux and to a number of electric tramways and railways in the district. It possesses three hydro-electric generating stations on the River Dordogne, and a steam-operated plant at Floirac, near Bordeaux, the total capacity being about 75,000 h.p.

Turkey.—According to the report of the Société Ottomane d'Electricité, of Constantinople, the output of the company's generating station during 1920 reached a total of 29,588,900 kWh, an increase of 3,892,400 kWh, over 1919, notwithstanding the fact that during part of the year the running of the tramways was held up and that certain industries were greatly depressed. At the end of 1920 the company was supplying energy to 17,207 consumers, as against only 12,894 at the end of 1919, the biggest increase being in the lighting department. The company's mains now extend to a length of about 186 miles. Owing to the depression in trade and industry generally, the demand for electricity, particularly for power purposes, has not this year been maintained, the output for the six months ending June last showing a falling off. Notwithstanding this, the plant at the power station is being increased by two new boilers and a 10,000-kilowatt turbo-generator, which, however, are not expected to be put into operation until the spring of next year.

Norway (Christiania).—There was a serious fire at the electricity works last Friday, and the central parts of the city were without power and light all day. It is expected that several weeks will be required for the complete repair of the damage.—*Reuter's Trade Service* (Christiania).

Crediton.—Electricity Supply.—A canvass is to be made of prospective consumers of electricity with a view to a supply being obtained from the Exeter Corporation power station at Cowley Bridge.

Electricity District.—South-East Lancashire.—The Electricity Commissioners are to hold a local inquiry at the Town Hall at Manchester on January 17th, 1922, at 10.30 a.m., and on following days, with reference to the above-named area, and to consider a scheme that has been submitted by the South-East Lancashire Electricity Committee for the establishment of a joint board.

Guernsey.—New Plant.—In order to meet increased demands the Guernsey Electric Light & Power Co. is to install new generating plant at its St. Peter-Port and St. Sampson's stations. The engines will be of the Diesel crude-oil type, aggregating 700 h.p., made by Messrs. Mirrlees, Bickerton and Day, Ltd. The generators are being made by the Electric Construction Co., Ltd.

Guildford.—Revised Charges.—The Town Council will adopt the following scale of charges for electricity as from December 31st: Lighting, up to 10 units per quarter, 10s.; next 1,000 units, 10d. per unit; beyond, 9d. Power and heating, up to 1,000 units per quarter, 4d.; next, 3,000, 3d.; beyond, 2d. Prepayment consumers, 1s. per unit. Theatres and kinemas, up to 100 units per week, 8d.; beyond, 5d.

Lancaster.—Loan Sanctioned.—The Town Council has received sanction to borrow £7,600 for extensions to the electricity works.

Lowestoft.—Year's Working.—The accounts of the Corporation electricity undertaking for the year ended March 31st last, show a total income of £39,803, as compared with £29,601 in 1919-20. The expenditure on revenue account amounted to £37,584, as against £23,394, leaving a gross surplus of £2,219 (£6,207). Of this capital charges absorbed £4,832, as compared with £3,861, causing a net deficit of £2,613, comparing unfavourably with a net profit of £2,346 in the preceding year.

Nelson.—Loan.—The Town Council has applied to the Ministry of Transport for sanction to the borrowing of £2,600 for the laying of electricity cables.

Scarborough.—Revised Charges.—The Electric Supply Co. has applied to the Electricity Commissioners for power to amend the charges for electricity for lighting purposes for the quarters ending March 31st and December 31st, up to 15 units, 15s.; and for each unit over 15, 1s. For the quarters ending June 30th and September 30th, up to 10 units, 10s.; and for each additional unit, 1s.

Seaham Harbour.—Electricity Supply.—The consulting engineer to the Seaham Harbour Urban District Council has reported on a proposed scheme for the distribution of electrical energy for public and private consumption.

Skegness.—Revocation of Powers.—The Ministry of Transport has revoked that part of the Skegness Urban District Council Act, 1914, relating to the supply of electricity throughout the area. The order dates from November 29th.

South Africa.—Kokstad (Cape Province).—The ratepayers have sanctioned a scheme for electric lighting at an estimated cost of £15,000.

Southampton.—Year's Working.—The annual report upon the Corporation electricity undertaking (Engineer: Mr. W. G. Turner, A.M.I.E.E.) for the year ended March 31st last, shows a total revenue of £143,216, as compared with £111,992 in 1919-20. Working expenses amounted to £110,654, as against £86,714, leaving a gross profit of £32,562 (£25,278). The net result was a surplus of £10,587 comparing favourably with a net profit of £4,709 in the preceding year. Against this profit, however, capital expenditure out of revenue, amounting to £11,382, was debited, causing an actual deficit of £795. The number of units sold rose from 10,570,248 to 10,916,989.

West Bromwich.—Reduced Charges.—The Electricity Committee has recommended that as from December 1st the price of electricity for power purposes be reduced by 12½ per cent., representing the last increase. No recommendation has been made for a reduction in the charges for lighting.

York.—Deferred-payment Wiring.—The city electrical engineer recently reported to the Electricity Committee upon the question of free wiring and schemes dealing with wiring on the deferred payment system, and the committee instructed him to prepare an estimate of the cost of wiring certain houses, and to canvass the residents to ascertain if they desired to have a supply of electricity by the fitting up of their houses on the basis of a deferred payment of the cost over a term of three years.—*Yorkshire Herald.*

Trial of Apparatus.—To encourage the use of electrical appliances, arrangements have been made for occupiers of houses on the Tang Hall Estate to test the efficiency and convenience of electric irons and heating apparatus. A number of people have been encouraged in this way to purchase appliances.

TRAMWAY AND RAILWAY NOTES.

Australia.—Adelaide.—Year's Working.—The accounts of the municipal tramways for the year ended July 31st last show a total revenue of £555,421, an expenditure of £362,823, and a gross profit of £162,597. After the payment of all capital charges a net surplus of £6,723 remained. In the preceding year a surplus profit of £5,948 was realised.

Western Australia.—The annual report of the Commissioner of Railways on the Government tramways for the year ended June 30th, 1921, shows a total revenue of £224,892, as compared with £187,981 in the previous year. Working expenses accounted for £204,459, leaving a gross profit of £20,433. After deduction of capital charges there was a net deficit of £9,334. In the previous year there was a net surplus of £10,106.

Birkenhead.—Improvements Deferred.—The Tramways Committee has rescinded a resolution regarding the proposed expenditure of £99,800 for carrying out work on certain tramway routes to provide work for the unemployed.

Continental.—Italy.—The State railway administration has received permission to electrify the remainder of the Genoa-Ovada Alessandria line to the extent of some 81 km., of which 20 km. will be in tunnels. The line is one of heavy traffic, amounting last year to about 80,000,000 km.-tons, coal costing about 1½ million lire. With the increase of traffic anticipated to follow electrification, the line is expected to require 7,000,000 kWh, at a cost of 700,000 lire.

Darlington.—Year's Working.—There was a loss on the corporation tramways for the past year of £3,166 as compared with £3,744 in the previous year.

Edinburgh.—The Brussels System.—The manager of the Corporation tramways has been in communication with Les Tramways Bruxellois, to obtain this company's opinion of the system in use in Brussels. The information was sought for guidance in the adoption of a system for Princes Street upon the electrification of the city tramways. According to the *Edinburgh Evening News* the Brussels company regards conduit systems unfavourably. The cost of upkeep, as compared with that of trolley lines, is double; there are three or four times as many accidents; and the company would be glad to be able to substitute overhead traction in the place of the conduit system. It is estimated that the conduit lines increase the cost of operation by 1,000,000 francs a year.

Halifax.—Extensions and Track Renewals.—The Halifax Tramways and Electricity Committee recommends the Corporation to apply for grants under the unemployment emergency work provisions, to take in hand forthwith the following extensions; the laying of 2,350 yd., of extra-high-pressure mains from Water Lane to Salterhebble, at £3,150; 2,810 yd. from Hangar Hill to Huddersfield Road, at £3,466; 2,280 yd. of tramway feeder from the depot to Salterhebble, £1,601; cable from Wood Street to Chester Road, £1,544; relaying inward tramway track from Springhall Lane to Cow Green, £23,500; double line on the Queensbury route near Cavendish Hotel to avoid risk of cars being overturned by wind, £4,200.

London.—Christmas Tramway Services.—It has been decided to follow the practice of the last two years with regard to the running of the London tramways on Christmas Day. All cars will be returned to their depôts by 4 p.m., and all men who can be spared will be given leave of absence for the day.

Stalybridge.—Christmas Tramway Services.—The Tramways and Electricity Board has issued a notice to its employés intimating that if they refuse to work on Christmas Day they will break their continuity of service, and will forfeit two days' holiday next year.

TELEGRAPH AND TELEPHONE NOTES.

Afghanistan.—Telegraph Service.—In recognition of the generous hospitality shown by the Ameer of Afghanistan to the Dobbs Mission, the Government of India has presented the Ameer with sufficient telegraph material to link up the 460 miles separating Kabul from the Indian telegraph extension at Herat *via* Kandahar, says *The Times.*

Australia.—Long-distance Wireless.—The Radio Communication Co., claiming to be an exclusively British concern, has made an offer to the Commonwealth Government to establish direct wireless communication with the United Kingdom. The offer, which differs in several respects from that put forward recently by the Amalgamated Wireless Co., [as announced in this column recently] is being considered by the Government.—*The Times.*

The Commonwealth Government proposed to bring the present session of the Federal Parliament to an end on December 9th, and hoped before then to deal with wireless schemes.

China.—Wireless Installations.—The Sub-committee on Drafting of the Washington Conference has adopted the tentative plan presented last week by Mr. Root for dealing with wireless installations in China. Under Mr. Root's plan, which will be reported back to the main Far Eastern Committee at the next meeting, the use of wireless would be restricted to diplomatic and governmental messages. Those installations permitted by Chinese licence would be used only to the extent authorised by the licence, and the Powers would co-operate with the Chinese communication authorities to secure that the wave lengths were not interfered with.—*Reuter's Trade Service* (Washington).

Finland.—Telegraph Service.—A mixed Finnish and Russian Commission has reached an agreement with reference to telephone, telegraph, and temporary railway communication. The terms of the agreement, it is expected, will be published shortly.—*Reuter's Trade Service* (Helsingfors).

France.—Telegraphic Delay.—A breakdown, caused by severe frost, on the French telegraph and telephone systems on November 30th, rendered communication between France and England very uncertain and slow for several days, says the *Daily Telegraph.* No communication at all was possible with Brussels.

Italy.—Wireless Telephony.—At the Centocelle Aerodrome on December 2nd, in the presence of the Ministers of Marine and Posts and Telegraphs, members of Parliament, and civil and military authorities, a wireless telephone service was inaugurated with Sardinia. In spite of bad atmospheric conditions conversations between Tempio Pausania and Rome were very clearly heard.—*Reuter's Trade Service* (Rome).

Netherlands.—Direct Telegraphic Communication with England.—The Director of the Telegraphic Services at Amsterdam announces in the *Board of Trade Journal* that direct telegraphic communication has been established between the Central Telegraph Office in London and Amsterdam. The opportunity of sending telegrams by means of this line is offered on every working day between 12.20 p.m. and 4 p.m., and on Saturday between 10 a.m. and 1 p.m.

Telephone Service.—Public Call Boxes.—During the past 12 months there has been a very considerable increase in the use of the Post Office public telephone boxes which are a feature of the Underground railway stations. It is estimated that nearly twice the number of people are now making use of these slot machines. The Underground Co. is co-operating with the Post Office to give facilities by arranging batteries of call boxes with a special attendant in charge. For the average private user, who only requires the telephone occasionally, this convenience is evidently one which is appreciated.

Proposed Automatic Equipment at York.—Mr. A. Bell, postmaster, has intimated to the Estates Committee of the Corporation that he is making every effort to secure the installation of the automatic telephone system at York. The lease of the present manual exchange in Parliament Street, belonging to the York Corporation, expires on June 1st next, but the Post Office has asked for permission to continue as yearly tenants pending a settlement of negotiations as to the use of the automatic system or otherwise. The Estates Committee has agreed, subject to a revision of rent on the expiry of the present lease.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—January 25th. Victorian Government Railways. Ten coasting recorders or, alternatively, 10 coasting and service recorders for the trains (cont. 34,736).

February 1st. Four motor-driven grinding machines, with accessories.*

February 15th. Postmaster-General's Department. Telephone apparatus and parts (Schedule 544). (See this issue.)

Blackpool.—December 23rd. Electricity Committee. One 5,000-kW, 3-phase turbo-alternator, surface-condensing plant with auxiliaries; one 2,000-kW, phase and frequency changer, complete with exciter and starting motor. (See this issue.)

Bolton.—For electric lighting at Cable Street Wesleyan Sunday School. Particulars from James Baxter, secretary.

Bradford.—December 24th. Electricity Department. Rotary converting plant (Cont. R.207). (See this issue.)

Dublin.—December 12th. Dublin United Tramways Co. (1896), Ltd. General stores, including electric supplies, for six months. (November 25th.)

Edinburgh.—Tramways Department. 53 trucks and electrical equipment of cars. Manager, 2, St. James's Square, Edinburgh.

December 19th. Electricity Supply Dept. Insulated cable for five months. (See this issue.)

Egypt.—Alexandria.—December 21st. Port and Lighthouse Administration. Stores, including electric lamps, for six months.*

Glasgow.—December 13th. Education Authority. Electric lighting of schools. J. Clark, Director of Education.

Lanark.—District of the Middle Ward. Electrician's, &c., work in connection with the new workshops at Hairmyres Sanatorium and Colony. Mr. P. C. Smith, Housing Department, District Offices, Hamilton.

London.—H.M. Office of Works. December 14th. Electrical and mechanical engineering labour-in-daywork in connection with the maintenance, &c., of installations in the Glasgow and Edinburgh districts during a period of three years from January 1st, 1922. Contracts Branch, H.M. Office of Works, London, S.W.1.

Shoreditch.—January 3rd. Electricity Supply Department. One water-tube boiler of 33,000 lb. evaporative capacity. (See this issue.)

Manchester.—December 14th. Supply, &c., of two electrically-driven capstans and three dummy capstans at Bradford Road gasworks. Specification, &c., from Mr. G. W. Kaye, secretary, Gas Department, Town Hall, Manchester.

December 13th. Tramways Committee. Motors and controllers. J. M. McElroy, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

New Zealand.—Wellington.—March 6th. Public Works Tender Board. Waikato power scheme. Two 2,500-kVA alternators, two 3,100-h.p. water turbines, two exciter sets.*

January 17th. Post and Telegraph Department. 25,000 dry cells for telephone work.*

South Africa.—Johannesburg.—January 4th. Municipal Council. Two 2,000-kW converters, with switchgear and spares.*

Uruguay.—Monte Video.—December 30th. State Electricity Department. Power station plant: one 4-stroke Diesel engine, coupled to a 200-kW, 3-phase alternator, and one 4-stroke Diesel engine, coupled to a 300-kW, d.c. generator.*

*A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Nineteen firms last week submitted tenders to the municipal authorities of Ghent for six static transformers for the local electricity supply station. The tenders ranged from 51,160 to 83,035 fr., the lowest being that of the Société Electrique de Nancy. The quotation of the Metropolitan-Vickers Co. was 73,440 fr.

Canada.—According to the *Montreal Star*, the Hydro-Electric Power Commission of Ontario has just concluded a contract with the English Electric Co. of Canada, Ltd., for traction equipment for the new Hydro-Radial cars at Windsor and Guelph. This is the first large order for traction equipment placed by the Commission; it will be manufactured at the St. Catharine's plant of the English Electric Co. The equipment ordered is similar to that recently purchased from the English Electric Co. by the Toronto Transportation Commission and now in use on its new cars.

Russia.—The British Mannesmann Tube Co., which recently received an order for 15,000 telephone poles for the Dutch East Indies in face of the keenest German competition, has just obtained a large order for boiler tubes for the All-Russian Co-operative Society. They are to be shipped to Archangel. This order is the first from Russia received locally for many years.—*Financial Times.*

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, December 9th. At the Royal United Service Institution, Whitehall. At 7.30 p.m. Presidential address by Mr. C. H. Wordingham.

Friday, December 16th. At the Caxton Hall, S.W. At 7.30 p.m. Extraordinary general meting. At 8 p.m. Paper on "Notes on Searchlight Construction and Operation," by Mr. A. J. Simpson.

Physical Society of London.—Friday, December 9th. At the Imperial College of Science, S. Kensington. At 5 p.m. Ordinary scientific meeting.

Birmingham & District Electric Club.—Saturday, December 10th. At the Grand Hotel, Colmore Row. At 7 p.m. Annual meeting.

Electrical Power Engineers' Association (Southern Division).—Monday, December 12th. At the Engineers' Club, Coventry Street, W. At 7 p.m. Adjourned discussion on "Notes on Boiler-House Plant."

Illuminating Engineering Society.—Tuesday, December 13th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "Progress in Gas Lighting in Relation to Illuminating Engineering," to be opened by Mr. W. J. Sandeman.

Institution of Civil Engineers.—Tuesday, December 13th. At the Institution, Great George Street, S.W. At 6 p.m. Papers on "Deep-water Quays: General Considerations of Design," by Mr. E. Latham, and on the "Stability of Deep-water Quay-walls," by Mr. F. E. Wentworth-Shields.

Association of Mining Electrical Engineers (London Branch).—Tuesday, December 13th. At 46, Kingsway, W.C. At 6 p.m. Discussion on "Types of Cable Covering for Collieries; Bitumen, Paper and Lead and Vulcanised Rubber."

Liverpool Engineering Society.—Wednesday, December 14th. At the Royal Institution, Colquitt Street. At 8 p.m. Paper on "Mechanical Cargo Handling," by Mr. G. Rae.

Nottingham Society of Engineers.—Wednesday, December 14th. At the Welbeck Hotel. At 8 p.m. Annual dinner.

Association of Engineers-in-Charge.—Wednesday, December 14th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Paper on "Utilisation of Exhaust Gases from Internal Combustion Engines," by Major W. Gregson.

Institution of Electrical Engineers.—Thursday, December 15th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "Induction-type Synchronous Motors," by Mr. L. H. A. Carr.

(East Midland Sub-Centre).—Tuesday, December 13th. At the Loughborough College at 6.45 p.m. Paper on "Whirling of Shafts." By Prof. C. H. Bulleid.

(Liverpool Sub-Centre).—Monday, December 12th. At the University, Liverpool. At 7 p.m. Paper, "Single and Three-phase Commutator Motors, with Shunt and Series Characteristics," by Dr. S. P. Smith.

(London Students' Section).—Friday, December 9th. At 7 p.m. At the Ship Restaurant, 45, Charing Cross, S.W. Smoking concert.

(North-Eastern Centre).—Tuesday, December 13th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Paper on "The Cye-Arc Process of Automatic Electric Welding," by Messrs. L. J. Steele and H. Martin.

(North Midland Centre).—Tuesday, December 13th. At the Hotel Metropole, Leeds. Ordinary meeting.

(North-Western Centre).—Tuesday, December 13th. At the Engineers' Club, Manchester. At 7 p.m. Informal meeting. Discussion on "Supply of Power Station Auxiliaries."

(Scottish Centre).—Tuesday, December 13th. At 207, Bath Street, Glasgow. At 7.30 p.m. Paper on "The Cye-Arc Process of Automatic Electric Welding," by Mr. L. J. Steele and Mr. H. Martin.

Saturday, December 17th. At the Grosvenor Restaurant, Gordon Street, Glasgow. At 7 p.m. Smoking concert.

Manchester Wireless Society.—Thursday, December 15th. At the Albion Hotel, Piccadilly, Manchester. At 8 p.m. Paper on "Recording of Wireless Telegraphy," by Mr. R. Brooke.

Chemical Society.—Thursday, December 15th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary meeting.

Chelmsford Engineering Society.—Thursday, December 15th. At the East Anglian Institute of Agriculture. At 7 p.m. General discussion.

Belfast Association of Engineers.—Thursday, December 15th. At the Municipal College of Technology. Paper on "Ball and Roller Bearings," by Mr. A. W. Macaulay.

Institution of Mechanical Engineers.—Friday, December 16th. At the Institution, Storey's Gate, St. James's Park, S.W. At 6 p.m. Papers on "Conveying and Elevating Machinery," by Mr. G. Mitchell, and on "Discharge of Grain Cargoes in the Port of London by Pneumatic Elevators," by Mr. R. E. Knight.

Electro-Harmonic Society.—Friday, December 16th. At the Great Hall, Cannon Street Hotel. At 8 p.m. Smoking concert.

NOTES.

E.R. Service Department.—The only inquiry that we have not been able to solve this week is the following: A correspondent seeks the name and address of the factors of the "Vulcan" soldering iron, made in Buffalo, U.S.A.

Educational.—On December 2nd the annual prize distribution of the Northampton Polytechnic took place. The Principal, Dr. Walmsley, spoke of the progress which was being made, mentioning that enrolments during the past year numbered over 3,800. Following the presentation of the prizes by Mr. A. Barton Kent, the students and members of the staff gave gymnastic and swimming exhibitions.

Royal Technical College, Glasgow.—The recently-published report on the 125th session records a further increase in the numbers of students in all classes; the number of enrolments during 1920-21 was 14,603. The accounts show an adverse balance of about £950. Full details of scholastic successes, appointments and resignations are given in the report.

The Influence of Transformer Connections on Third Harmonic Voltages and Currents.—With reference to the article under the above title, which was published in the Electrical Review of March 11th, 18th, and 25th, 1921, the author (Mr. S. Austen Stigant) informs us that some errors crept into Table I, p. 302, and that the accompanying table should be substituted for the original version. The chief correction is that with a constant effective voltage and a sine-wave of no-load current, the resultant peaked pressure wave produces a lower iron loss than does a sine-wave of pressure of the same effective value.

Constant B max.

Flux,			Induced Voltage		No Load Current	
Wave Shape	Form Factor Compared To Sine Wave.	Iron Loss Compared to that with Sine Wave Flux	Wave Shape	Form Factor Compared To Sine Wave.	Wave Shape	Form Factor Compared To Sine Wave.
Sine.	Same	Same	Sine.	Same.	Peaked Third Harmonic in Opposition	>
Flat Third Harmonic in Phase.	<	Same	Peaked Third Harmonic in Opposition	>	Sine.	Same
Constant E.eff.						
Sine.	Same	Same	Sine	Same	Peaked Third Harmonic in Opposition	>
Flat. Third Harmonic in Phase	<	<	Peaked Third Harmonic in Opposition	>	Sine	Same

Wave-Shape Relationship between Flux, Induced Voltages and No Load Current

Appointments Vacant.—Switchboard attendant, for the Sandy Lane power station of the Coventry Corporation Electricity Department; watchkeeping engineer (59s 6d.+39s. 1d.) for H.M. Dockyard, Portsmouth. (See our advertisement pages to-day.)

The Electro-Harmonic Society.—The next smoking concert will be held in The Great Hall, Cannon Street Hotel, on Friday, December 16th, 1921, commencing at 8 p.m. Sir James Devonshire, K.B.E., will occupy the chair, and the artistes will be:—Miss Winifred Kennard, soprano; Mr. Barrington Hooper, tenor; Mr. Harry Dearth, baritone; Mr. Bernard Turner, humour with saxophone; Mr. W. V. Robinson, Canadian entertainer; Mr. Wilson James and Mr. Harry Davson, entertainers; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist.

Disabled Ex-Service Men.—The Ministry of Labour has issued an appeal to employers to enrol on the King's National Roll, in view of the decision that Government contracts shall be given only to firms whose names are on that Roll. Invitations to firms already enrolled to renew their undertakings will shortly be issued. Up to the present, the Roll embraces 29,000 names, covering some 365,000 disabled Ex-Service men; 25,000 men are in training under the Ministry's schemes, and there are 25,000 more on the waiting list. During the past 13 weeks "improver" vacancies have been found for 1,929 trained men.

The Cycle and Motor-Cycle Show.—This year the above named popular show was again housed in Olympia, it being the seventh of the series of annual exhibitions promoted by the British Cycle & Motor-Cycle Manufacturers' and Traders' Union, Ltd. So far as electrical matters were concerned, attention was confined to the accessories section, where many makes of lighting and ignition equipments, &c., were on view. The stand of Messrs. C. A. Vandervell & Co., Ltd., was of interest to both motor-cyclists and manufacturers alike. The long awaited C.A.V. dynamo lighting set for motor-cycles was shown both on "solo" and "combination" machines.

The dynamo for these installations is only 3¼ in. in diameter, but it is built on identical lines with the standard C.A.V. car-lighting models. The output is 5 amps. at about 1,000 r.p.m., an ample charging rate to cover all ordinary lighting requirements, which may include a dashlamp, spotlight, &c., The battery, a special "C.A.V.-Willard," has an actual capacity of 3 amps. for 10 hours. This should be registered at an official "C.A.V.-Willard" service station, as it is eligible for exactly the same free service benefits as its larger brothers are for car lighting and starting. Headlamps and special sidelamps were exhibited in various designs and sizes for different type of cycles. The solo motor-cyclist was not neglected and special batteries have been produced for this purpose.

The winner of the highest awards on road and track during 1921, Mr. Victor Horseman, on his Norton machines, invariably used C.A.V. magnetos, a testimony to their merits.

The combined lighting and ignition system of the Villiers Engineering Co., Ltd., has been developed from its well-known and highly-efficient h.p. flywheel magneto. The system is simple, and the magneto has no additional moving parts; the additions comprise a pair of coils and a terminal with suitable connection. The current given off is alternating, and the voltage is constant above 2 miles per hour. There is no risk of burning out the bulbs, provided those used are supplied by the makers.

The pair of lighting coils have no electrical connection with the ignition coil. They are connected in series with each other; the one end of the coil is earthed; the free end of the other is led to the lighting terminal and so to the lamps. An insulated terminal is fixed to the armature plate, and a quickly detachable fastening provided for the cable. A dry battery is used for lighting purposes when the machine is stationary, but immediately the engine is fired the rider has only to switch over on to the magneto to get a brilliant light, consequently the battery is only used occasionally, and will therefore last for a considerable period.

All Villiers motor-cycle engines are being equipped with magnetos suitable to take the lighting coils, and it is a very simple matter at any time to fit the coils, by unscrewing the pole shoes. The lamps are connected in series; the bulb used in the front lamp is of 4-volt, 3-ampere capacity, and the rear bulb 4-volt, 5-ampere capacity.

Every part of the magneto is easily accessible, and inspection of all parts may be made by simply removing the cover.

As its name implies, the magneto is built into and made part of the flywheel, and it is claimed that a quarter of a turn of the flywheel will generate enough current to spark the plug. Also that it is absolutely waterproof, and that with the ordinary type of magneto the angle of advance and retard is limited, and in the retard position the spark is very much weaker than in the advance, whereas in the Villiers magneto the same intensity of spark is obtained in all positions. The amount of space that can be devoted to the armature and winding is greater than in any other magneto, and makes provision for fitting a more efficient coil and contact breaker.

Another flywheel magneto set was exhibited on the stand of the British Thomson-Houston Co., Ltd., and a number of firms showed magnetos, lamps, accumulators, electric horns, &c., suitable for use on motor cycles.

Municipal Tramways Conference.—The Newcastle-on-Tyne Transport and Electricity Committee of the City Corporation has decided to invite the Municipal Tramways Association to hold its annual meeting in the city next September.

A Lecture on Artificial Heating.—National Association of Supervising Electricians.—On Tuesday, December 13th, at St. Bride's Institute, E.C.4, Mr. J. W. Beauchamp, M.I.E.E., will read a paper entitled "Artificial Heating in Relation to Human Needs." Major T. Vincent Smith, M.C., M.I.E.E., President of the Association, will take the chair at 6.45 p.m. The paper will deal with:—

1. The influence of temperature upon health and work.
2. The relative values of radiant and convective heat transmission.
3. Quantitative ideas on artificial heat.
4. Waste of heat energy.
5. Electricity as a heating medium and its relation to other means of providing artificial heat.
6. Influence of modern methods of heating upon the design and cost of buildings and their upkeep.
7. Modern forms of electric heating, heat storage, efficiencies and costs.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Examination Results.—The list of successful candidates who sat for the A.M.I.E.E. examination in October, 1921, shows that eight passed the whole examination and two passed Part II only. In addition, 37 officers of the Royal Engineers passed the whole and 18 Part II only of the examination. The results relating to candidates who sat for the examination abroad are to be published later.

London Students' Section.—On November 11th the opening address of the session was delivered by Sir Philip Dawson, M.P., who took as his subject "The Future of Railway Electrification." He said that one of the main advantages of electric traction over steam traction was the very smooth torque obtained, which resulted in a greater drawbar pull. This was of the order of 25 per cent. of the deadweight, whereas that of steam was only about 16 per cent. Sir Philip outlined the recommendations of the Electrification of Railways Advisory Committee. The sole criterion of the practicability of an electrification scheme was its financial soundness. The speaker gave some figures in comparison of d.c. and a.c. traction. He thought that a.c. struck the "happy medium" in operating costs while having a substantially lower initial cost. Statistics of the working of the electrified portion of the L.B. & S.C. Railway demonstrated the increased traffic capacity brought about by electrification.

East Midland Sub-Centre.—Mr. C. H. Bulleid will read a paper on "Whirling of Shafts, with special reference to Turbine and Dynamo Shafts," on December 13th at Loughborough. The paper will be illustrated by lantern slides and a demonstration of models will be given.

Western Centre.—A meeting of the Centre took place on December 5th at the Merchant Venturers' Technical College, Bristol, when the chairman (Mr. A. C. McWhirter) presided over a large muster of members and visitors. The event of the evening was the paper on the "Cyc-Arc" Process of Automatic Welding," which is abstracted elsewhere in this issue. One of the authors (Mr. Martin) received his technical education at the Merchant Venturers' Technical College, of which he is an associate. The paper was illustrated by interesting lantern slides, and prior to the discussion Mr. Martin carried out practical demonstrations of the process. The discussion will be reported in a later issue.

South Midland Territorial Centre.—On Friday last the annual dinner of the Centre was held at the Grand Hotel, Birmingham; Mr. R. A. Chattock, chairman of the Centre, presided, and there were present about 170 members and guests, including the Lord Mayor of Birmingham (Ald. D. Davis), Councillor H. K. Beale, chairman of Electric Supply Committee, Dr. G. Kapp, Dr. A. H. Railing, Dr. W. E. Sumpner, Mr. J. S. Highfield (president I.E.E.), Prof. W. Cramp, Ald. W. Walker, Dr. C. C. Garrard, Major A. M. Taylor, Mr. F. Forrest, Mr. E. C .R. Marks, Mr. A. C. Wynne, Mr. T. P. Wilmshurst, Mr. A. W. Willett, and Mr. R. B. A. Ellis.

After the loyal toast, Mr. Chattock proposed "The Institution of Electrical Engineers," drawing attention to the facts that this was the jubilee year of the Institution, and that the Institution had obtained a Royal Charter. Reviewing the history of the Institution, he said he did not see how it was possible for it to have nothing to do with trade; all its efforts were directed to fostering the trade and industry on which this country exists. The Institution did much to develop the brains of the electrical industry, and the Territorial Centres enabled the papers and discussions to be brought before an enormous number of members, whilst the research work promoted by the Institution was of great value to the industry. He looked forward to the time when membership of the Institution would be an indispensable qualification for an engineering post.

The President, Mr. J. S. Highfield, responded, explaining the excellence of the constitution with its world-wide Territorial Centres, and the value of the Royal Charter, which was in effect a mandate from the State to the Institution to carry on its work. He urged that the base of the Institution should be widened by bringing in men such as Lord Southborough, its new honorary member. Care must be taken to ensure that a high standard of qualification for membership was maintained; the examination test alone was too academic, and a certain amount of practical work should be called for. After eulogising the excellent work done by the retiring hon. secretary, Mr. J. D. Morgan, he dealt with the proposal put forward by Sir Henry Strakosch and Sir Peter Rylands, that Germany should erect super-stations and electrify railways in this country, pointing out that the effect of it on the British electrical industry would be disastrous. The Institution was keeping its eyes open to the danger.

Ald. W. Walker proposed "The City of Birmingham and Electricity Supply," commenting on the engineering achievements of the City. He paid a high tribute to the merits of Prof. Cramp, whose removal to Birmingham was a great loss to Manchester, and expressed the confident opinion that trade had taken a turn for the better. The Lord Mayor, responding to the toast, said that the great abilities of Prof. Cramp were fully appreciated in Birmingham. The City had made great efforts to produce munitions during the war, and was now paying the penalty in the form of more unemployment than other cities experienced. Mr. Chattock in 18 years had transformed the City electricity supply, and was held in the highest esteem by the citizens.

Councillor Beale also responded, referring to the difficulties Birmingham had met with in its endeavours to cope with the demand for electrical energy. He deprecated the outlay of large amounts of capital on new power stations before they knew there was a market for the output.

Prof. W. Cramp, proposing "Kindred Societies and Guests," acknowledged the kind welcome that he had received as a newcomer to the City, and expressed the view that the engineering societies should draw together in one great body of engineers, of which they could all be members. To this end he suggested that the presidents of the institutions should be persuaded to meet and discuss the proposal. If they did not join hands now, in 10 or 20 years they might be in fierce competition.

Mr. E. C. R. Marks responded in a humorous speech, attributing the formation of the Institution of Mechanical Engineers to the rejection by the Institution of Civil Engineers of George Stephenson's application for membership. He was not sure that Dr. Cramp was right in wishing to bring them all together.

A programme of music accompanied the dinner, and afterwards a conversazione and concert took place.

Scottish Centre.—The Centre has issued to its members a small handbook containing a great amount of information. This embodies the annual report for session 1920-21; a full list of officers and past-chairmen; annual reports of the Dundee Sub-Centre and the Students' Section; programmes for the present session; extracts from the Institution's Articles of Association; and a list of members of the Centre.

On Saturday, December 17th, a smoking concert will be held at the Grosvenor Restaurant, Gordon Street, Glasgow, at 7 p.m. Tickets (2s. each) are obtainable from Mr. W. L. Winning, 166, St. Vincent Street, Mr. Neil M'Killop, Corporation Electricity Department, 75, Waterloo Street, or from members of the committee.

Chelmsford Engineering Society.—On November 24th a paper was read before the society on "Gas Producers for Power and Heating Purposes," by Mr. N. E. Rambush, Chief Engineer of the Power-Gas Corporation, Ltd. The President (Mr. G. F. Barrett, O.B.E.), was in the chair, and a hundred members were present. Mr. Rambush first dealt with the various methods of producing gas: (1) Town gas supplies, where only 25 per cent. of the fuel was turned into gas. (2) (*a*) Complete decomposition of fuel by the air gasification process; and (*b*) complete decomposition of the fuel by a mixture of air and steam.

A large number of diagrams of various types of generators was shown, and each was fully explained.

The speaker said that the thermal efficiency of various methods of producing gas was roughly as follows: Producer gas from bituminous coal, 72 per cent.; producer gas from anthracite coal, 80 per cent.; town gas using the coke in a producer, 66 per cent.; blue water gas plant, 45 per cent.

Mining Institute of Scotland.—Over 80 members of the Institute recently visited the works of Messrs. Anderson, Boyes & Co., Ltd., Motherwell, and inspected the manufacture of coal-cutting machines and mining switch-gear, in which the firm specialises. The visitors also witnessed experiments relative to the presence of gas in mines and the safety of electrical plant.

Edinburgh Electrical Society.—On November 23rd Mr. A. S. Black delivered a lecture on "The Manufacture of the Modern Electric Lamp." The subject of illumination as it affected filament design was touched on, as also were the new chemical processes connected with gasfilled lamps. The lecturer described the methods of lamp manufacture in use at the Osram works, and illustrated his descriptions by lantern slides and samples.

Bradford Engineering Society.—Before the Bradford Engineering Society, last week, at the Technical College, Mr. A. A. Liardet (Thwaites Bros., Ltd., electrical engineers) lectured on "Radio-Telegraphy." The chair was occupied by Mr. C. E. Allsop, sales manager to the Bradford Corporation Electricity Department, and president of the Association. Mr. Liardet, after dealing with the basic principles of radio-telegraphy, demonstrated both the production of waves by the oscillatory discharge of an induction coil and the later developments in production by rotary high-frequency generators, or by the use of a thermionic valve. During the evening signals were received from large stations in England, France, Germany, Central Europe, Moscow, and from shipping and coast stations. Speech and song were received from Mr. Denison, at Halifax, and heard by the whole audience, and a member of the committee of the Association, as an experiment, spoke to the meeting from a house in another part of Bradford.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. R. A. CHATTOCK, the City Electrical Engineer of Birmingham, who is now filling the chair of the South Midland Centre of the Institution of Electrical Engineers for the second time, he having been chairman of the section in 1906-7, has served as a member of the Council of the Institution for six years, and has been a vice-president for three years. He occupied the position of President of the Incorporated Municipal Electrical Association at Birmingham in the year 1913-1914. As we stated last week, evidence of his popularity was given at the recent electrical engineers' ball, held in that city.

Mr. Chattock was born in 1865 at Hull, in Warwickshire, and educated at University College School, London, from which he passed in 1881 into the college, where he remained until 1884, going through the full engineering course under Professor Kennedy, and obtaining the senior Gilchrist engineering scholarship. After serving an apprenticeship as a mechanical engineer in the shops of Messrs. John Stewart and Son, in 1889, he took up a position of assistant engineer to the Metropolitan Electric Supply Co. at its several stations

Mr. R. A. CHATTOCK,
Chairman of the South Midland Centre of the Institution of Electrical Engineers, 1906-1907 and 1921-1922.

in Whitehall, Manchester Square, and Sardinia Street, London, and in 1892, on erection of the company's new station in Amberley Road, Paddington, he became superintendent engineer at that station. In 1894 Mr. Chattock was appointed chief electrical engineer to the vestry of St. John, Hampstead, London, and in May, 1895, took up the position of superintendent engineer at the Bankside station of the City of London Electric Lighting Co., which position he retained for a period of five years. In March, 1900, he was appointed chief electrical engineer to the Bradford Corporation, and was responsible for large extensions in connection with the electricity department. He resigned this position in 1903 consequent upon his present appointment as City Electrical Engineer at Birmingham. During the time Mr. Chattock has been at Birmingham he has had entire charge of the development of the Corporation electric supply undertaking. This has comprised the design and erection of the large power station in Summer Lane and a number of sub-stations in the outlying districts of the city, which are supplied with three-phase current at a pressure of 5,000 volts, and in which the current is transformed by means of rotary converters into direct current for general distribution. The station has also been designed to give a supply of power to the whole of the tramways in the city. A supply of three-phase current at 5,000 volts pressure to large power users has also been developed. The large generating station at Summer Lane, Birmingham, for the design of which Mr. Chattock was responsible, was completed in 1914, and is of the total capacity of 35,500 kW. Prior to the war Mr. Chattock was engaged upon the design of a large generating station, the ultimate capacity of which will be 105,000 kW, and a commencement was made on the building work early in 1914. During the war, however, the building of this station was stopped at the request of the Government. Subsequently, when there was a shortage of power in the district for making munitions, arrangements had to be made for rushing up a temporary station, close to the site of the proposed large station, having a capacity of 22,000 kW. This station was running in nine months from the date the building was commenced. In 1918 the Government sanctioned proceeding with the big station at Nechells, and work has been carried on, with the result that the first section is now practically complete, and it is expected to be running in January, 1922. During the 18 years that Mr. Chattock has been connected with the Birmingham Corporation the load has increased from 3,545 kW to 67,100 kW, the revenue has increased from £67,278 to £1,293,521, and the units sold from 3,737,419 to 136,921,417.

Ald. GEO. NEW has been re-elected chairman and Ald. WM. WALKER vice-chairman of the Sunderland Corporation Tramways Committee.

Mr. H. D. DAVIES, the manager of the Heywood Corporation Electricity and Tramways Department, who was appointed assistant general manager of the Chesterfield Corporation Electricity Tramways and Motor 'Bus Department, has decided to stay at Heywood, where the authorities have agreed to increase his salary by £50 per annum and also to allow him 5 per cent. commission on the net profits of the Electricity Department.

Mr. LINCOLN CHANDLER has resigned his position as managing director of the Metropolitan Carriage, Wagon and Finance Co., Ltd., and his seat on the directorate.

Mr. G. J. CHURCHWARD, C.B.E., the chief mechanical engineer of the Great Western Railway, will retire at the end of the year. The directors have appointed Mr. C. B. Collett, O.B.E., the deputy chief mechanical engineer, to succeed him.

It is stated that Mr. JAMES MILNE, B.Sc., A.M.I.C.E., has been appointed an assistant to the general manager of the G.W.R. He relinquishes the post of head of the Statistical Department of the Ministry of Transport

Mr. W. BROWN, A.M.Inst.C.E., A.M.I.E.E., late resident engineer of the North Metropolitan Electric Power Supply Co., at Barnet, has been appointed H.M. Electrical Inspector of Factories, with headquarters in Leeds. Captain R. M. Moberley left St. Albans on November 1st to succeed Mr. Brown as resident engineer.

SIR T. O. and LADY CALLENDER have left West Heath House, Abbey Wood, and their address now is Bidborough Court, Kent, near Tunbridge Wells.

Mr. H. C. SOULE, who for some time past has been manager of the apparatus department of the Westinghouse Electric International Co., with headquarters at East Pittsburgh, sailed from New York, on November 19th, for Buenos Aires, Argentina, where he will take up duties in the office of Mr. L. T. Peck, managing director of the Cia. Westinghouse Electric Internacional, S.A., of Argentina.

Mr. HORACE BOOT, consulting engineer, is standing as an independent Conservative candidate for the forthcoming by-election at South-East Southwark.

Mr. J. LEADBEATER has been appointed electrical engineer and manager of the Hampstead electricity supply undertaking in place of Mr. W. Wyld, who recently resigned. For some time Mr. Leadbeater has occupied the position of chief assistant engineer.

Mr. W. A. TOPPIN, on leaving the Chesterfield Corporation, was presented with a roll-top desk by the employés of the electricity, tramway and 'bus departments. His new address is Toppin & Knowles, Ltd., electrical engineers, 202, Manningham Lane, Bradford.

Obituary.—MR. F. HUTH JACKSON.—The death has occurred at the age of 58 years of the Rt. Hon. Frederick Huth Jackson, a director of the Bank of England, a former president of the Institute of Bankers, and president of the National Association of Employers and Employed. He was also a director of the Eastern Telegraph Co., Ltd., and of the British Trade Corporation.

Mr. M. B. MOUNTAIN.—We regret to announce that Mr. Montague Brown Mountain, M.I.E.E., consulting engineer, of 66, Victoria Street, London, S.W., passed away suddenly last week from pneumonia, at his residence, Home Glen, St. Margarets-on-Thames. He was fifty-eight years of age. Mr. Mountain had been for many years connected with electrical and mechanical engineers. He was the son of the late Charles George Mountain, of Messrs. May & Mountain, of Birmingham, and served his apprenticeship with that firm. In about the year 1890 the deceased gentleman opened a Glasgow office for the General Electric Co., Ltd., and later became the Glasgow agent to Messrs. Ernest Scott & Mountain, and joined this firm as works manager at a later date. Mr. Mountain was a brother of Mr. W. C. Mountain, of Newcastle-on-Tyne. He was works manager to Messrs. Crompton and Co., of Chelmsford, for some years, and left that firm to join the British Westinghouse Co. in the building of their

works in Manchester, and afterwards he was engaged with the firm in connection with tramway work. Later on he established the firm of Mountain & Gibson, of Bury, and manufactured a considerable quantity of tramway material. During the war he was engaged upon the manufacture of aeroplane parts, and later joined the Ministry of Munitions. At the termination of the war he joined Messrs. The Roneo, Ltd., and was engaged largely upon the supply of Wilson's roller shutters, and other specialities.

Will.—The late Sir Samuel Davidson (Davidson & Co., Belfast), left £185,818.

NEW COMPANIES REGISTERED.

Hitchcock's Magnetic Engine Co., Ltd. (178,055).—Private company. Registered November 26th. Capital, £250 in £1 shares. To acquire interests in certain existing inventions and patent rights relating to magnetic engines. The subscribers (each with one share) are: S. I. Hitchcock, 38, Fox Hill, Upper Norwood, S.E.19, engineer; E. R. Ramsden, Hampden Club, N.W.1, director of a company. The first directors are not named. Registered office: 32, Fenchurch Street, E.C.

Spensers (Scotland), Ltd. (11,952).—Private company. Registered in Edinburgh November 26th. Capital, £9,000 in £1 shares (3,000 10 per cent. preference). To enter into an agreement between A. H. F. Hodgson and the Receiver and Manager of the estate of Spensers, Ltd., and to carry on business as manufacturers of and dealers in electric and gas plant, machinery, motors, apparatus, and appliances of every description. The first directors are: A. H. F. Hodgson, 119, George Street, Edinburgh, lighting engineer; H. Plucknett, 119, George Street, Edinburgh, electrical engineer. Registered office: 119, George Street, Edinburgh.

Electric Line Fittings, Ltd. (178,097).—Private company. Registered November 29th. Capital, £1,000 in £1 shares. To carry on business as indicated by the title and that of manufacturers and producers of and dealers in machinery, plant, articles and appliances, &c. The first directors are: H. W. Burnett, Glenthorne, Doncaster, railway wagon manufacturer; T. Burnett, Windsor Road, Doncaster, railway wagon manufacturer. Qualification: 100 shares. Remuneration as fixed by the company. Secretary: H. W. Burnett. Registered office: Hexthorpe Wagon and Wheel Works, Hexthorpe, near Doncaster.

Premier Accumulator Co. (1921), Ltd. (178,158).—Private company. Registered December 1st. Capital, £40,000 in £1 shares. To carry on the business of accumulator manufacturers as formerly carried on by the Premier Accumulator Co., Ltd., at Northampton. The first directors are: H. Stephens, "Southwood," St. George's Avenue, Northampton; G. A. Schanschieff, "North View," Marriott Street, Northampton; F. C. Vine, 45, Dungate, Northampton. Qualification: £100. Remuneration (except managing directors, if any) as fixed by the company. Solicitor: A. E. Phipps, 4, Wood Hill, Northampton.

H. Arrowsmith & Co., Ltd. (178,034).—Private company. Registered November 25th. Capital, £2,000 in £1 shares. To take over the business of manufacturers of electrical goods, switches, adaptors, magnetos and spare parts, and motor car and magneto repairers and motor engineers carried on by Henry Arrowsmith and Harry Arrowsmith at Manchester as "H. Arrowsmith & Co." The permanent directors are: Henry Arrowsmith, 4, Romney Street, Moston, Manchester (chairman); Harry Arrowsmith, 28, Leighton Street, Moston, Manchester. Qualification: £100. Remuneration as fixed by the company. Secretary: Henry Arrowsmith. Registered office: 269a, Deansgate, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

North Wales Power & Traction Co., Ltd.—Particulars of £1,000,000 (including £250,000 already registered) authorised September 26th, 1921, and covered by trust deed dated July 29th, 1919, and November 2nd, 1921; present issue of £300,000 in addition to £200,000 outstanding, charged on benefit of prior deed of July, 1919, lands, hereditaments, and premises, referred to therein and benefit of agreement with the Aluminium Corporation, Ltd., for the supply of energy. Trustees: Unity Investment Trust, Ltd., and Lord Morris.

Fluxio Welding Co., Ltd.—Debenture dated November 8th, 1921, to secure £1,000. Charged on company's undertaking and property, present and future. Holder: J. Cheetham, "Newbold," Newton Drive, Blackpool.

Conner Magneto and Ignition, Ltd.—Debenture dated November 14th, 1921, to secure £100,000, charged on company's undertaking and property, present and future. Holders: General Electric Co., Ltd., Magnet House, Kingsway, W.C.2.

Armature Repairing and Supply Co., Ltd.—Issue on November 1st of £2,000 and on November 21st, 1921, of £200 debentures, parts of a series already registered.

A.G.E. Electric Motors, Ltd.—Particulars of £18,000 debentures authorised November 14th, 1921; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

Electric Motors (South Wales), Ltd.—Satisfaction in full on October 6th, 1921, of mortgage or charge dated October 26th, 1920, securing £5,000.

Wilson Hartnell & Co., Ltd.—Satisfaction to the extent of £1,000 on November 9th, 1920, of debentures dated December 22nd, 1902, securing £2,500.

East Anglian Electricity, Ltd.—Satisfaction in full on November 10th, 1921, of debentures dated July 26th, 1916, securing £1,000.

Laminated Gears, Ltd.—Issue on November 22nd, 1921, of £600 debentures, part of a series already registered.

Bourne End and District Electricity Corporation, Ltd.—Issue on November 23rd, 1921, of £200 debentures, part of a series already registered.

CITY NOTES.

The India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.

At the annual meeting held at the Company's offices, 106, Cannon Street, E.C., on November 30th, Major Leonard Darwin, who presided, said that as regarded trade generally the year had been a disastrous one, a disaster which, if repeated, would not only bring that firm to ruin, but would half ruin the whole country. The causes were, no doubt, well known to them all, but might be stated as follows, in the excellent words spoken by the Chairman of Lloyd's Bank to his shareholders in February last, for since that date there had been only a partial recovery. He said:—

"Rarely, if ever, has such a dramatic change occurred in so short a time as took place in trading conditions in this country in 1920. At the beginning of the year practically every trade was enjoying extremely active and prosperous conditions, manufacturers being unable to cope with the insistent demand for goods. Apparently price was no object provided goods could be obtained. This led to an orgy of speculation, when prices were forced up to an alarming figure. It soon became evident to all cautious observers that the position was becoming one of some danger. At the same time consumers, both at home and abroad, became unwilling, and in most cases, unable to pay the inflated prices demanded. The check thus given to inflation gradually became more pronounced, and in the autumn stocks began to be unloaded at greatly reduced figures. Then occurred the coal strike, which inflicted a heavy blow on the declining trade, and by the end of the year industry as a whole was suffering from extreme depression, with very great unemployment as a natural concomitant. It should be emphasised, however, that the root of the trouble is not over-production, but under-consumption. The necessary corollary is that production must be further expanded, thereby enabling prices to be further reduced, and so stimulating consumption."

The accounts presented were for 11 months' trading to August 31st, 1921, instead of the usual period of one year ending on September 30th. This was to enable them more easily to meet the requirements of the Finance Act, 1921, which provided for the termination of Excess Profits Duty and for certain assessments, adjustments, and repayments necessary for that purpose. The total difference in the valuation of the commencing stock at prices ruling at September 30th, 1920, and at those ruling on August 31st, 1921, was £407,149, on which figure their rebate was calculated, and from that fact it would be seen that the loss on the 11 months' trading was due, very largely, to the diminished value of the commencing stocks. Over the period of seven years ended September 30th, 1920, during which Excess Profits Duty was enforced, they were assessed in a total sum of £435,603, of which only £32,587 now remained unpaid. As against this, and arising out of the re-valuation of their various stock, they were in a position to reclaim duty in a sum approximating to £224,000 gross, or to £156,752 after allowing for income tax thereon, a figure which had been taken to the credit of the profit and loss.

The turnover at Silvertown for the 11 months from October 1st, 1920, to August 31st, 1921, was only 50 per cent. of that of the preceding year, this reduction being due to the general slackness of trade, which reduced both the quantity of deliveries and the prices obtainable. The only shop showing an increased turnover was the golf ball shop, where the turnover for the 11 months was 43 per cent. greater than for the 12 preceding months. The rubber department shops, the telegraph shops, the instrument shops, and the battery department, had turnovers which were more than half as much as in the preceding year, whilst in all other manufacturing shops the turnover was less than half. The shop which most reflected the results of the year was the tire department, where the turnover was rather less than 25 per cent. of that of the preceding year. This great decrease in the sale of tires was very largely traceable to conditions common to all British tire manufacturers. Work generally was seriously interfered with by strikes which occurred in other trades. The difficulties of obtaining fuel necessitated the entire closing of the factory for 3¼ weeks, the working of half-time practically throughout the whole period of the coal strike, and short time working even after the end of the strike. Moreover, they were only able to keep the factory running under these conditions by going to the expense of fitting up half their boilers to burn oil fuel.

The market value of their raw and partly-manufactured material, which was in stock at the end of September, 1920, fell rapidly during the following five months to about two-thirds of its September value, with the result that sales of finished goods could only be effected by writing down very materially the cost of the bought-in materials. They had been free from any disputes with their own workpeople, and had been able to arrange for reduction in the bonuses given during the war period. The French trade prospects had been improving steadily, and they had already had to increase their output at Persan. To sum up the cause of their losses, they were ultimately traceable to unsettled markets, foreign dumping, reduction of working hours, high rate of pay, low standards of work, increased overhead charges, external strikes, and heavy taxation, with a consequent decrease in

production. On one supposition, and one supposition only, he emphatically repeated his impression at the previous meeting of the most complete confidence in the ultimate future of the company. This supposition was that the whole of their team would not only work hard, but would pull well together. The team included all in any way concerned with the company: office boys, labourers, mechanics, foremen, staff, directors, and also the shareholders. Before the country could regain a healthy economic position the whole country must face in that spirit the hard times through which we were going to pass.

Mr. C. H. Gray seconded the motion, which was carried unanimously.

The Eastern Extension, Australasia & China Telegraph Co., Ltd.

Sir John Denison-Pender, G.B.E, (Chairman), presided at the annual general meeting, held in London on November 30th. He said that the enforced postponement of the meeting had not prevented the distribution of the final dividend of 10 per cent., free of tax, as the directors considered it justifiable from the estimates placed before them. The revenue, compared with 1913, had risen by over 300 per cent., and, in view of the prevailing commercial depression, the financial result was not unsatisfactory. It had not been found necessary to provide any further sum for depreciation of reserve fund investments, owing to previous provision, which covered this depreciation. The principal items of increased expenditure were due to revised staff salaries and special allowances, and the heavy cost of cable maintenance. Referring to the balance sheet, the Chairman said that the new capital, which was practically all taken up by shareholders, had been added to the Capital Account, and the account had been debited with £559,824 as part payment for the new Madras-Singapore cable, and for the acquisition of land and staff buildings at many of the company's stations. At the last meeting reference had been made to delays in transmitting the Far Eastern and other traffic, and the hope was expressed that cable repairs and renewals would in a short time bring the system up to the pre-war efficiency in working. Owing to numerous adverse circumstances this had proved difficult of accomplishment, but progress was being made, and it was hoped that shortly the public would have a faster service, even in times of serious interruptions, in the main line sections. The motion for the adoption of the report and accounts was seconded by Sir A. J. Leppoc Cappel, K.C.I.E., and carried.

Col. Burt asked whether recent developments in wireless telegraphy, such as the construction of a station for direct communication between this country and Australia, and the development of thermionic valves for telephony, would adversely affect cable companies. In reply the Chairman said that, although he would make no prophecy regarding wireless communication, he would point out that Germany, who was supposed to be "well up" in wireless, contemplated entering into an agreement with the big Atlantic companies for direct communication with the United States. Italy also was making endeavours to arrange direct cable communication with South America, and he thought that this pointed to the fact that the days of cables were not yet over. If wireless communication was more efficient it would cut them out, but there remained a lot of work to be done first.

Telephone Manufacturing Co. (1920), Ltd.

At the annual meeting, held on November 29th, the managing director said that the company was now a complete organisation, owning 13 subsidiary installation companies in this country, and controlling three abroad. The business of each installation company was to secure orders to install and maintain private installations in its allotted area. The system had become so popular that there were nearly 7,000 subscribers, paying at the present time an annual rental of £95,335, and their contracts provided for a total rental of no less than £948,868. Trade depression could have no effect upon the stability of those 7,000 agreements. All were binding, and could not be cancelled.

The installations themselves remained the property of the installation company, so that, in addition to the rental, they had the value of the installations themselves. A firm or company did not, as a rule, become a subscriber until it had enough offices or large enough works to justify an intercommunication telephone system, so that the £948,868 becoming due from so many thousands of substantial houses was as good a debt as it was possible to imagine. It had always been the practice to depreciate the value of all installations at the rate of 10 per cent. of the original cost per annum, and they had many installations still bearing revenue which stood at nothing. But as the installation companies did not sell the installations considerable capital was locked up. For that reason they proposed immediately to issue loan capital against those secured rentals. An issue was being made on their behalf of an issue of £300,000 guaranteed 8 per cent. cumulative income bonds, repayable over the next 14 years.

The accounts, covering a period of 19 months, showed a net profit, including dividends from installation companies, of £98,003. Of this £44,507, earned prior to the date of incorporation of the company, was being capitalised, and formed a very useful initial contribution to the reserves of the company. They proposed to apply £12,454 to writing down preliminary expenses, and from the £53,496 remaining available, to pay a dividend of 2s. per share, less tax, leaving £24,796 to be carried forward, subject to taxation. These results were only from eight installations companies, as five established recently had not completed their first financial year.

German Companies.

The accounts of the *Elektrowerke A.G.*, of Berlin, have been issued for the year ended March 31st, 1921. The company owns lignite mines and power stations in the Bitterfeld district for meeting the requirements chiefly of nitrogen works, and the whole of its share capital of 250,000,000 marks is held by the Commonwealth (Reich). The gross profits amount to 6,090,000 marks, of which 2,770,000 marks has been applied to depreciation and 1,350,000 marks placed to the renewal fund. The net profits are 850,000 marks.

The *Berlin Elektrizitats Werke, A.G.*, now practically an investment company, reports net profits of 13,809,000 marks for 1920-21, as contrasted with 5,781,000 marks in the previous year, and the dividend rises from 10 per cent. in 1919-20 to 18 per cent. last year. In conjunction with the A.E.G., the directors state that the company has acquired most of the shares in the Mix & Genest Telephone Co., whose business would complement that of the A.E.G. It is now proposed to increase the share capital by 39,400,000 marks to 118,500,000 marks, and to alter the name of the company to that of a bank for electrical securities.

The report of *Max Schorch & Co. Electrotechnical Works*, of Rheydt, states that the orders received in 1920-21 did not suffice for the full utilisation of the works, and a strike of nearly three months exercised an unfavourable influence on the results. Including the balance forward, the net profits amount to 1,596,000 marks, comparing with 1,577,000 marks in 1919-20. It is proposed to pay a dividend at the rate of 10 per cent., as in the preceding year, and to increase the share capital by 4,500,000 to 19,000,000 marks. The directors state that an improvement in business has taken place recently.

The *Telephonfabrik A.G.*, late *J. Berliner*, of Hanover, reports gross profits of 4,431,000 marks for 1920-21, as compared with 1,497,000 marks in the previous year. After setting aside 275,000 marks for depreciation, as against 139,000 marks, the net profits and balance forward are returned at 4,331,000 marks, as contrasted with 1,535,000 marks in 1919-20. The rate of dividend has been increased from 15 per cent. to 20 per cent., and it has been decided to raise the share capital from 20,000,000 to 40,000,000 marks. It is stated that all departments are well stocked with orders.

Allgemeine Elektrizitats Gesellschaft.

The report of the directors of the Allgemeine Elektrizitats Gesellschaft for the year 1920-21, states that the situation of trade became less favourable in the final quarter. Since then, however, the demand had again revived, more so than in other countries, as the industries, which were very actively occupied, were extending and complementing their power installations, the electrification of agriculture was progressing, and work was proceeding for the extension and amalgamation of the largest electricity works. The community of interests with the Felten and Guilleaume Co. had stood the test, and the manufacturing agreement with the Osram Co. had also hitherto corresponded to expectations. As to the new relations established during the year, the report mentions those entered into with the Linke-Hofmann Locomotive Works, the Rhenish Metalware and Machinery Works, and the porcelain works of Ph. Rosenthal & Co., of Selb. The share capital of the A.E.G. was increased by 300,000,000 to 850,000,000 marks, of which 350,000,000 represents ordinary shares, and the premium of 94,100,000 marks realised on the capital issue in May increased the reserve fund to 168.67 millions of marks.

The report proceeds to state that most of the workshops were well occupied during the year. Generators for an output of up to 20,000 kW were constructed for various hydro-electric works. The removal of the transformer factory to the large shops at Oberschonweide was completed so that the company was now able to cope with the large demand; and transformers of up to 80,000 kW had been delivered in large numbers. The degree of activity at the Oberspree cable works was smaller than usual in the spring; the department for light and power cables had been well occupied and the telephone cable branch had been abundantly supplied with orders. It had been possible for the locomotive works materially to increase its turnover, and adequate orders were still on hand for home and foreign account. A further satisfactory development had taken place at the electric steel works and rolling mills at Henningsdorf, and in order to place the works on a wider basis it had been transferred to a separate company, with the co-operation of the Linke-Hofmann Co., and the Lauchhammer Iron & Steel Co.

The technical departments for the execution of individual installations were abundantly occupied for the heavy iron and steel industry; and foreign iron and steel producers placed orders for complete electrical installations for iron and steel works. A not inconsiderable number of orders was received for large generators for hydro-electric works. The company possessed valuable patents for earth connection coils, according to Prof. Petersen, which had already come into extensive use; and the Pfankuch cable protection system was enjoying increased popularity, so that the favourable experience with both systems had resulted in large repeat orders. The textile industry was pro-

ceeding to take advantage of the electric drive. Concerning the electricity supply industry, the report states that the orders received for large sets plainly showed the revival in the supply business. In the establishment of power stations the promoters availed themselves of the experience of the A.E.G., so that there was a growing desire to have the entire installations carried out by the company. As an instance, mention is made of the Provinciale Zeeuwsche Electriciteits Maatschappij, of Middleburg, Holland. A large number of orders for generators for hydroelectric works were booked, a further demand was experienced for rectifier installations, while many orders for transformers of large output were also received. The business in electric tramway plant had been very quiet, large orders having almost exclusively emanated from other countries. A benzol motor lorry was brought out in conjunction with the National Automobile Co. The electrification of ordinary railways was making but slow progress. A summary of the financial results for the past two years, and for 1916-17, is given below :—

	1916-17 Marks.	1919-20 Marks.	1920-21 Marks.
Share capital	184,000,000	310,000,000	850,000,000
Gross profits	46,793,000	80,295,000	247,913,000
Depreciation	1,100,000	3,418,000	2,023,000
Net profits and balance forward	30,370,000	45,707,000	82,388,000
Dividend	23,000,000	28,000,000	50,000,000
,, per cent. ...	12½	14	16
Carried forward ...	1,180,000	807,000	1,505,000

The accounts further show that a total of 5,500,000 marks was allotted to the payment of bonuses, pension fund, and war benevolent fund in 1916-17, 16,000,000 marks in 1919-20, and 17,000,000 marks in 1920-21. The balance sheet records open reserves amounting to 288.67 millions of marks, the current accounts' account appears under the assets at 1,010,000,000 marks as compared with 438,010,000 marks in 1919-20, and of the former the company's own bank credit is given at 657,940,000 marks, as against 26,400,000 marks a year ago, the bank credit exceeding all the company's floating liabilities.

The Western Telegraph Co., Ltd.

The annual general meeting was held in London on November 30th. Sir John Denison-Pender, G.B.E., who presided, referred to the death of Lord Balfour of Burleigh, who had been a director for 16 years. Turning to the accounts, he said that, although the balance of profit was not so large as in the previous year, it was satisfactory, having regard to adverse exchange conditions and slackness of trade. These last two circumstances were responsible for a decrease in revenue, partly offset by increases in other items, of £610,000. There was a reduction of £381,000 in the item of taxes and the E.P.D., having terminated so far as the company was concerned in July last, would not appear in the next accounts. The cable laid, in conjunction with the Western Union Cable Co., from Brazil to Barbadoes, was still lying idle in consequence of the refusal of the United States' Government to permit the landing of the cable in Florida. The company hoped that a decision would be arrived at shortly, as, in the meantime a valuable direct communication between South America and the United States was being held up, while the traffic was mainly passing over the lines of the company's competitors. The renewal of the older section between Lisbon and Madeira had been completed, and arrangements were in progress to carry out a similar renewal of the original Madeira-St. Vincent cable early next year. Upon the completion of this the cable steamer would commence laying a new cable between Pernambuco and Maranham, other cables connecting Pernambuco with Maceio, Victoria, and Rio de Janeiro, and a third cable between Rio de Janeiro and Santos, thus materially strengthening the coast connections. This work would entail an expenditure of £700,000, bringing the total cost of renewals and fresh lines since 1918 to £3,000,000. The fund for covering depreciations in the Reserve Fund Securities required no further assistance during the year, and the value of the securities could still be taken as £2,500,000. They could not hope for improvement in message revenue until the exchanges became settled, bringing a revival of international commerce and trade. The Earl of Midleton, K.P., seconded the motion for the adoption of the report and accounts, which was carried. The retiring directors were re-elected.

Aluminium Corporation, Ltd.

When the company met in October it had not been possible to prepare the accounts and the meeting was adjourned until such time as they should be ready. Mr. K. M. Clark, however, addressed the meeting, and said that they had succeeded in obtaining sufficient orders to keep the rolling mill working full time. The work upon the Cowlyd Dam had been continued, and they were now engaged in the removal of the plant and the completion of the pitching. They still required to construct the Leet connecting the Cowlyd Lake with the Llugwy Lake, and once this was done they would have a greatly improved water supply. Their relations with the North Wales Power and Traction Co. had been intensified during the past year, and they had assisted that company in its arrangements for the building of a considerable portion of its transmission system, for when this was brought into operation a large portion of this company's energy would be sold to the North Wales Power & Traction Co. They believed they had made an arrangement with that company that would, to a considerable extent, place this corporation in a position of independence as regards the aluminium market, and ensure a more profitable use of the energy. The Electricity Commissioners held a very lengthy public inquiry at Llandudno in February, and issued a judgment announcing their intention to create the North Wales Power & Traction Co., the authorised distributors for electric energy in the North Wales and Chester electricity district. The application by the North Wales Power Co. was made in conjunction with this company, and the conjoint working of the two companies would have very satisfactory results.

Prospectus.—*The Telephone Manufacturing Co.* (1920), *Ltd.*—This company, whose business is referred to in the report elsewhere of the meeting held last week, has been inviting applications (until December 8th) for an issue of £300,000 guaranteed 8 per cent. cum. income bonds at £96 per cent. The issue is for the purpose of repaying advances from the bank and for the future development of the business.

The prospectus states that: "Amongst the many valuable patents and rights owned by the company may be mentioned . . . the Telegraphone . . . an entirely new device for the automatic recording and giving of telephone messages." If this is really "an entirely new device" the choice of name is unfortunate, for the reason that Mr. Valdemar Poulsen, the well-known Danish engineer, exhibited at Paris in 1900 an appliance, for exactly the same purposes, which *he* called the "Telegraphone." We described this apparatus fully in our issues of April 27th (p. 687) and October 12th (p. 573) of the year mentioned. It was stated in the latter reference: "The Telegraphone is already in practical operation in several telephone stations in Denmark." This was over twenty years ago.

Stock Exchange Notices.—Dealings in the following securities have been specially allowed by the Stock Exchange Committee under Rule 148a :—

Midland Counties Electric Supply Co., £400,000 7½ per cent. mortgage debenture stock, issued at 96 per cent., partly and fully paid, after issue of allotment letters.

Anglo-Portuguese Telephone Co.—250,000 shares of £1 each, fully paid (Nos. 150,001 to 400,000).

Johnson & Phillips.—£350,000 8 per cent. first mortgage debenture stock.

Metropolitan District & London Electric Railways.—£142,400 Joint Power House 4 per cent. rent charge stock.

Newcastle-upon-Tyne Electric Supply Co.—The Financial Press states that a meeting of holders of second mortgage debenture stock is to be held on December 9th, to consider resolutions increasing the rate of interest from 5 to 6 per cent., and authorising an additional £1,500,000 of stock, making the total authorised amount £2,000,000. The directors propose to issue to the public shortly £750,000 additional stock in order to meet the requirements incurred in connection with extensions of the stations and the development of the business generally.

Claud Hamilton, Ltd.—According to the *Financial Times* the accounts show, after writing off depreciation, paying preference dividend, and transferring £6,210 to general reserve, a balance of £17,245 to be carried forward, subject to E.P.D. and Corporation tax. No dividend is recommended on the ordinary shares, but it is proposed to capitalise £3,000 of general reserve fund and distribute this amount among the ordinary shareholders as fully-paid bonus shares in proportion of one for every ten shares held.

New York Edison Co.—It is stated that the issue of $30,000,000 New York Edison Co. first Lien and Refunding Mortgage 20-year 6½ per cent. bonds, offered to the public in New York at 104¼, and interest, was immediately oversubscribed.

Chilian Electrical Fusion.—The *Financial Times* reports that the Chilian Electric Tramway Co. and the National Electric Power Co. have concluded negotiations for amalgamation. The capital of the new company will be £12,000,000, of which the major portion will be found in London.

Marconi International Marine Communication Co., Ltd.—Interim dividend of 5 per cent., less income tax.

Western Telegraph Co., Ltd.—First quarterly dividend 5s. per share free of tax, being at the rate of 10 per cent. per annum.

New Issues.—According to the Financial Press an issue will be made by the Llanelly and District Electric Lighting and Traction Co. of £125,000 7½ per cent. debenture stock at 94.: and one by the Reading Electric Supply Co., of £100,000 in 7½ per cent. debentures at 95.

Power Gas Corporation, Ltd.—After putting £4,000 to reserve, a dividend of 6 per cent. per annum less tax, is to be paid, carrying forward £11,594.

Brazilian Traction, Light & Power Co.—A quarterly dividend of 1¾ per cent. on the cumulative preference shares is announced.

Pinchin Johnson & Co., Ltd.—Interim dividend of 5 per cent., less tax.

Manx Electric Railway Co.—Net receipts £18,982, plus £1,390 brought forward. The preference dividend is to be paid in respect of the year ended September, 1916, and £916 is to be carried forward.

United Wire Works, Ltd.—Dividend of 5 per cent. on the ordinary shares, free of tax, £1,500 to general reserve, £4,281 carried forward.

Coventry Chain Co., Ltd.—A final dividend of 7 per cent., less tax (making 10 per cent. for the year) on the ordinary shares, is announced.

Waygood-Otis Co., Ltd.—Interim dividend at the rate of 5 per cent. per annum on the ordinary shares.

STOCKS AND SHARES.

TUESDAY EVENING.

STOCK EXCHANGE markets are certainly moving towards brighter conditions. There is more business doing than of late, and the approach of the Christmas holidays fails to exercise any check upon the activities of the bargain-hunter and of people who want to take advantage of the low levels of prices existing in most industrial companies' shares, for instance, where the prospect of the undertakings are reasonably well-assured for the future. Report after report shows losses as compared with a year ago. On every fall in shares, however, it is noticeable that buyers come forward to pick up anything that is going cheaply. The contention is that the current year for industrial concerns is likely to prove the worst, so far as the writing-down process is concerned, and the gradual improvements in various trade directions are held as evidence that the bottom of the slump has been reached, and that industry is now set towards a more cheerful prospect.

The settlement arrived at in the early hours of Tuesday morning, between the Government and Sinn Fein, has relieved the Stock Exchange from the incubus which has pressed upon the markets for months. Removal of this blanket of fear made its effect felt immediately. Prices responded in all directions. Buying orders came in from quarters which hitherto had been retaining money on deposit at the banks, apprehensive of a fresh outbreak of civil strife in Ireland. A note of hesitation was heard as to Ulster's possible part in the proceedings, and the best prices were hardly maintained.

Electrical stocks and shares hardened with others, but, as a good many of the principal issues have been rising during the past two or three weeks, the effect in the markets with which we deal was less noticeable than in some other parts of the Stock Exchange. The cable group, indeed, is dullish, owing to the diminished profits shown by the Eastern group and referred to in last week's number of the ELECTRICAL REVIEW. Eastern ordinary is easier at 160½, while the share members of the group remain heavy at 16¾. Anglo-American Telegraph deferred, however, has risen to 17¼. Marconis enjoyed a sharp recovery, the price of the parent shares rising 3/16 to 1 11/16. The advance came on the top of the interim distribution of 5 per cent. on Marconi Marines which caused the price of the latter to jump sharply to 21s. 6d. Radio Corporation shares are being tipped as a speculative lock-up to those who have money to spare for such a purpose. The ordinary are 10s. 3d. and the preference 9s. 9d. Extremely vague rumours are in the air with reference to certain developments said to be afoot between some of the Marconi companies. These have assisted the better tone; otherwise they are too vague to deserve even a passing reference.

Home electricity issues are holding their ground. Westminsters at 5¼ are ¼ better. City of London preference strengthened to 18s. The feature, however, is the strength of the new County of London debenture stock. The price has risen to 9½ premium. Ample though the security is, the price, which is equivalent to 103½ for the fully-paid stock, looks too high as against the quotations of some of the other stocks of its kind. The British Thomson-Houston 7 per cent. debenture stock, offered at 92, started off at ¾ discount when the market began, but the price has since hardened to ¼ premium. The Midland Electric 7½ per cent. debenture stock, issued the other day at 96, is now negotiable, the price being ¼ to 1 premium.

Home Railway stocks have had one of their spasmodic spurts, gains of several points being registered by most of the leading stocks of the steam companies. The Undergrounds keep pace in the movement. Metropolitans have risen 1¼ to 25½. Districts are 2 higher at 18. The Underground stocks and shares are still somewhat dull, the £10 shares giving way to 5¾, but the income bonds rallied a couple of points to 67½. Mexican Light & Power first mortgage bonds have risen to 61¼, and the Common shares to 13, showing improvements of 4 and 3 points respectively. The outlook in Mexico is regarded as clearer, and the speculator is searching for such bonds as are likely to show substantial gains in capital value when a final agreement is reached between Mexico and the United States. Some like the Mexico Tramways 5 per cent. bonds, in which a further rise of 2 points has occurred this week, while the more gambling element leans to the company's 6 per cent. bonds standing at 27½, with seven years of unpaid coupons, which will require to be dealt with in course of time. The Firsts are, of course, receiving part of their interest arrears, and seem to offer a reasonable chance to the speculative investor, the others falling at present, at any rate, somewhat into the category of simple speculation.

Up to Tuesday evening the allotments of the £300,000 Telephone Manufacturing 8 per cent. cumulative income bonds offered at 96 had not been received, so far as we are aware. The Llanelly and District Electric Lighting & Traction Co. is about to issue £125,000 7½ per cent. debenture stock at 94, and the Reading Electric Supply Co. is asking 95 for £100,000 in 7½ per cent. debentures. If the financial atmosphere is cleared by a real settlement of the Irish problem, it is bound to be the case that a good many new issues will be made, possibly before the New Year, because investment stocks have already gone up on the strength of the hope that, with Irish peace, money from the distressful isle will come to this country to swell the funds already available for investment.

Amongst manufacturing shares, Cromptons at 13s. 9d. are 9d. lower. English Electrics at 10s. have regained their loss of last week, but the preference at 12s. 6d. are 1/16 down. Henley's gave way to 29s. 3d., and Metropolitan-Vickers preference to 1¾. There is not much doing in this department.

Babcock & Wilcox at 2 5/16 are a little lower, as compared with last week. Vickers remain weak, and the iron and steel market, although affected by the firmness which characterised most of the markets to-day (Tuesday), has not yet recovered from the heaviness that the Washington disarmament proposals brought about. Rubber, the produce, has been up to within ¼d. of 1s. per lb., but fell back again to 11½d., and share prices have been moving in correspondence. The Castner-Kellner Co. has a dividend of 13 per cent. for the year, as against 22 per cent. a year ago.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend. 1919.	Dividend. 1920.	Price Dec. 6, 1921.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	19	19	6¾	—	£9 18 0
Charing Cross Ordinary	7	8	4½	—	8 17 10
do. do. do. 4½ Pref.	4½	4½	8¼	—	7 4 4
Chelsea	4	6	8½	—	9 4 8
City of London	13	14	20/9	—	10 9 6
do. do. 6 per cent. Pref.	6	6	18/-	+6d.	6 13 4
County of London	8	8	8⅛	—	9 1 6
do. do. 5 per cent. Pref.	6	6	7⅛	—	7 10 0
Kensington Ordinary	7	9	4⅜	—	9 4 8
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	8	—	10 0 0
Metropolitan	6	7	8⅜	—	9 6 8
do. 4½ per cent. Pref.	4½	4½	2⅛	—	7 13 2
St. James' and Pall Mall	12	12	6⅜	—	8 17 10
South London	6	7	2⅜	—	10 13 2
South Metropolitan Pref.	7	7	10/6	—	8 12 4
Westminster Ordinary	10	10	5⅜	—	6 10 2
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	82½	—	7 5 7
do. Def.	1¼	1½	17⅛	+ ⅜	8 9 0
Chile Telephone	6	6	5¼	—	5 17 3
Cuba Sub. Ord.	7	7	7	—	10 0 0
Eastern Extension	10	10	16⅜	—	6 2 2
Eastern Tel. Ord.	10	10	161¼	—1	6 3 1
Globe Tel. and T. Ord.	10	10	16⅜	—	6 2 2
do. do. Pref.	6	6	9½	—	6 9 9
Great Northern Tel.	22	24	25	—	9 12 0
Indo-European	10	10	30	—	8 6 8
Marconi	25	15	1¼	+ 7/16	8 17 10
Oriental Telephone Ord.	12	12	2	—	*6 0 0
United R. Plate Tel.	8	8	5½	—	*7 0 8
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	16⅜	—	*6 2 2
HOME RAILS.					
Central London Ord. Assented	4	4	49½	—	8 1 8
Metropolitan	1½	1½	25½	+1½	5 17 8
do. District	Nil	Nil	18	+2	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	— ⅛	Nil
do. do. "A"	Nil	Nil	5/-	—	Nil
do. do. Income	4	2	67½	+2	*4 9 0
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams, First Pref.	5½	12½	2⅜	—	10 9 6
do. do. 2nd Pref.	Nil	5½	2½	—	10 4 8
do. do. 5 per cent. Deb.	5	5	63xd	—	7 18 8
Brazil Tractions	Nil	Nil	39	+1	Nil
British Columbia Elec. Rly. Pfce.	5	5	58	—	8 12 4
do. do. Preferred	5	93/-	51	—	*9 5 0
do. do. Deferred	3	124/-	56½	—	*10 14 6
do. do. Deb.	4½	4½	60	—	7 1 8
Mexico Trams. 5 per cent. Bonds	Nil	Nil	35½	+2	—
do. do. 6 per cent. Bonds	Nil	Nil	17⅝	—	Nil
Mexican Light Common	Nil	Nil	13	+3	Nil
do. Pref.	Nil	Nil	26	+1	Nil
do. 1st Bonds	Nil	5	61¼	+4	8 2 8
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	16	2 5/16	—1/16	6 18 9
British Aluminium Ord.	10	10	14/6	—	—
British Insulated Ord.	15	15	1¼	—	10 0 0
Callenders	15	15	1⅜	—	10 18 2
,, 6½ Pref.	6½	6½	18/9	—	6 18 8
Crompton Ord.	10	10	13/9	—9d.	14 11 0
Edison-Swan	10	—	5/8	—	—
do. do. 5 per cent. Deb.	5	5	64	—	7 16 3
Electric Construction	10	10	17/6	—	11 8 6
English Electric	8	8	10/-	+1/8	16 0 0
do. Pref.	6	6	12/6	— 1/16	9 12 0
Gen. Elec. Pref.	6½	6½	17/-	—	7 13 0
do. Ord.	10	10	17/-	—	11 15 4
Henley	15	15	29/3	—9d.	10 5 7
do. 4½ Pref.	4½	4½	8¾	—	6 8 8
India-Rubber	10	—	⅞	—	—
Met.-Vickers Pref.	8	8	1¾	— 1/16	9 2 10
Siemens Ord.	10	10	1 1/16	—	*9 8 2
Telegraph Con.	20	20	21½	—	*5 11 9

* Dividends paid free of Income Tax.

LEAVES FROM AN INSPECTOR'S NOTE BOOK.

By "ANODE."

Travelling round from works to works, as an inspector does, he becomes acquainted with all sorts and conditions of engineers, and the best criterion of the worth of the engineer is, naturally, the condition in which he keeps his plant.

In cases where the electrical equipment consists of a few motors they are generally cared for by either the mechanical engineer or a handy man, and I have found in these cases that the mechanical man has a profound suspicion of any device with an "electric wire" attached to it; in the event of any untoward incident occurring in connection with the electrical gear he promptly shuts it down, and obtains the advice or aid of someone qualified to give it.

The handy man, as a rule, keeps his machines clean, that is, if he can get at them without having to climb ladders and turn himself into a contortionist, and I had a few words to say on this point a few weeks ago, when speaking about the fixing of motors in inaccessible positions.

Then, in other cases, you have somebody who is great on taking everything adrift in order to see how it works. This is all right until one day he rewires up and gets a wrong connection on his starter, and the motor starts off on a weak field and races "some."

When you are called in he explains the whole affair to you with great wealth of detail, and enters into a learned discussion as to how the motor makers are weighed in the balance and found wanting, and how their only hope of salvation lies in engaging him as their chief designer and technical adviser.

In cases like this I listen with great reverence and attention to the words of the oracle, and then send him away for something, and while he is gone I change over the leads. On his return I ask him to start up the motor in exactly the same way as when the fault was noticed by him.

To his great astonishment the motor functions properly, and he is left stranded, and I am then in a position to admonish him as to the evil of making rash statements, and calling upon me and disturbing the even tenor of my way.

In one case I was very nearly let down, and this through my own carelessness. I had arranged to spend the week-end with some friends, and late on the Friday afternoon I was making my final inspection at a pork butcher's, where everything was generally O.K. On this occasion it was not so, and on testing through the whole machine and starter I got a very low reading, something like 10,000 ohms, whereas the usual reading was in the neighbourhood of 15 megohms.

This was distinctly annoying, inasmuch as it meant a possibility of losing my train, and in order to save time, I disconnected the leads from the starter to locate the fault.

The fault lay on a terminal insulator, and was easily rectified, and as soon as this was done I reconnected the leads to the starter and made tracks for the station. On the Monday I had a wire from Head Office asking me to proceed immediately to the pork butcher's, as his machine had broken down. This was not pleasant, as my report had gone in to Head Office saying that the motor was in good condition generally, and no defects were noted.

Arriving at the scene of the disaster I saw what I had done, viz., connected the starter up wrongly, and before the butcher arrived I changed over the leads.

When he appeared he raved at me and my company for a good long period, and I could not get a word in. At last I asked him to show me what was the matter, which he promptly proceeded to do, but the motor started up perfectly, and he was completely bowled out.

This little incident taught me a lesson, and I never made an inspection afterwards without running the machine.

Coming back to the topic I started on, in the case of works with a large number of machines there is generally an electrical engineer, whose duties are naturally confined to electrical matters.

In these cases you nearly always find the equipment in a high state of perfection, and defects are rectified directly they are noticed. In one works with over 300 motors in continual use, it was a very unusual occurrence to find any defects, but the electrical engineer was an exceedingly capable man, with a first-class staff of fitters under him.

On one occasion a field coil burnt out in one of the turbo-generator sets, and it was impossible to replace it till the week-end. He kept the set running on about half-load, and at mid-day on the Saturday he closed it down. By 4 p.m. the same day he had the top half of the generator lifted, the armature out, and the burnt-out coil removed. Those of my readers who are acquainted with d.c. turbo sets will appreciate what this means, especially when the voltage was 220 and the commutator was of the radial type.

This is easily the smartest piece of work I have witnessed, and I say without fear of contradiction that the maker's staff in their own works could not have beaten it.

This shows the value of experience, and it is to be regretted that these positions are not more often filled by practical men.

In the case of another works the engineer was a man of a totally different stamp, and his machines were in poor condition—not that he was in any way inferior to the gentleman just mentioned, as a matter of fact he could have beaten him hands down on theory, but he had not the knack of controlling his staff, with the result that he muddled along; as long as things went on comfortably he did not worry, and when the inevitable breakdown occurred, instead of having one fault to rectify, it generally meant that he had to move the machine for a complete overhaul, and more often than not he was at his wits' end to find a spare.

Had he gone about his work systematically he would have considerably lessened his responsiblity and kept his plant in a state of greater efficiency. On one occasion he had a breakdown in an old bipolar generator with a smooth-core armature. This machine was really due for the scrap heap, but owing to his lack of foresight he could not dispense with it, as at that time he could not get anything like a reasonable delivery of a modern direct-coupled set.

The armature was therefore sent away for re-winding, and it being found that the commutator was worn down to safe limits, it was necessary for a new one to be made. When the armature was delivered to him it was immediately put to work, and not even the elementary precaution of adjusting the brushes to the new commutator was taken, the result being that the surface of the commutator was damaged, the copper dust from it lodging at the back of the risers, and after 12 hours the set gave out through earths and shorts at the back of the commutator due to the dust. The result was that the armature had to be returned to the repairer and the commutator taken off and the faults cleared. While this was being done, the other set broke down, and the works were completely stopped for four days.

Had this engineer thought the matter over beforehand this would never have happened, and his firm would have been saved a very considerable amount; it would also have obviated a long and acrimonious dispute between his firm and the repairers, whom he had the gross impertinence to blame for the trouble.

A funny incident occurred once. I had to make a

first inspection of a small 3-phase, squirrel-cage induction motor, and as it was not installed I had no opportunity of seeing it running. I took all necessary dimensions, put the megger on it, found all in order, and passed it for insurance. The next day I had a visit from the alleged electrician, who said that he had ordered the machine for clockwise rotation, whereas it would only run anti-clockwise. On getting particulars of this distressing state of affairs, I found that he did not know that changing over any two of the stator leads would reverse the direction of rotation. Hence the pyramids.

AN ELECTRICAL REVIEW OF E.-H.-P. TRANSMISSION.

By R. BORLASE MATTHEWS, Wh.Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S.

Just over ten years ago, the writer summarised his experience, jointly with Mr. C. T. Wilkinson, of the above-mentioned subject, in a paper read before the Institution of Electrical Engineers (*Proc.*, I.E.E., Vol. 46, Part 207, 1911). At that time, the amount of h.p. transmission work in Europe was comparatively trifling. Since then, however, enormous strides have been made, and literally to-day the Continent is becoming covered with a close network of overhead sub-distribution lines, supplied by e.h.p. transmission systems. The writer has come across a considerable number of these latter systems in the course of systematic tours that he has been making lately to investigate the Continental development of the applications of electricity to agriculture—the economical exploitation of which is so intimately tied up with the provision of cheap and effective methods of transmitting electricity.

An excellent opportunity was afforded recently for obtaining a summary of the world's experience, up-to-date, in e.h.p. transmission practice, at the Paris International Conference concerning "Grands Reseaux de Transport d'Energie Electrique à Très Haute Tension." This formidable and unwieldy title was officially, though quaintly, translated into English as "Large Transmission Systems of Electric Power at very High Tension." The author, as mentioned last week,* now submits some notes gleaned from the papers read at the conference (some 56 in number), the formal discussions, and also from those informal discussions, which are so often of such great value, that take place unofficially between the official meetings set forth on the programme.

In pre-war days, European practice was largely based upon the designs and apparatus of German engineers —which, in turn, were developed from American schemes. With the advent of the war, most of this class of work stopped for a time. For one thing, plant ordered from German engineering firms could not be delivered; for another, the financial position was upset, and the nations at war had obviously something else to think about. However, in the second stage of the war, the neutral nations became very wealthy, while the warring nations needed more and more power for the production of munitions of war. Power has for some time been exported to the U.S.A. from the second highest British waterfall—Niagara, Canada. The North-East of Denmark is supplied with power from Sweden by a 3-mile long, 25,000-volt, electric cable under the sea. A special war work export transmission line is that between Goesgen, in Switzerland, and Pouxeux, in France— 112 miles (180 km.) in length, and designed for eventual operation at 110,000 volts, though now worked at 77,000 volts. The construction of this line was started in July, 1918, and it was completed in October, 1919; the load is 9,000 kW. This line is described in a paper read at the conference by M. Renoult.

As main divisions for the discussions, the programme was apportioned out as follows: (I) The generation and transformation of energy; (II) the construction of the transmission lines; (III) the operation and protection of the lines; and (IV) legislation affecting these works. In these notes, it is proposed to deal with the discussions in the same order.

(I) The generation and transformation of electricity, was chiefly dealt with by a discussion on: (*a*) alternator design; (*b*) transformer design; (*c*) controlling apparatus, *e.g.*, relays, switches, &c.; (*d*) open-air sub-stations; and (*e*) the difficulties associated with the parallel operation of stations.

As regards (*a*), chief attention was given to turbo-generators, in which connection Mr. F. D. Newbury (Pittsburg, U.S.A.) presented a most interesting paper. There is apparently not much difference nowadays, between European and American practice. European engineers have the advantage, however, in that they can obtain large steel forgings of better and more uniform quality, which permits of operation at higher stresses. Mica insulation is becoming the universal standard. European engineers are favoured in their designs in that 50 cycles is the normal standard, as compared with the American practice of 60 cycles. It was pointed out that building costs favoured a small number of larger sets. As regards the present ideas concerning the maximum possible ratings in two- four- and six-pole designs, to-day's limits of manufacture seem to be :—

2-pole	3,600 r.p.m.	10,000 kVA.
4-pole	1,800 r.p.m.	40,000 kVA.
6-pole	1,200 r.p.m.	80,000 kVA.

But difficulties of transport are a considerable factor, even within these limits.

As regards voltage, M. Hansson (Paris) stated that 6,000 volts was a suitable limit, though European practice employs pressures up to 12,300 volts.

The modern alternator of large size is frequently subjected to severe short-circuit tests and, in order to secure good regulation with variable load, it has been customary to specify a low voltage drop and, consequently, a low value of reactance. However, good protection is now considered to be of more importance, so an increase of magnetic leakage is provided for in modern alternators. In spite of a high voltage drop, the employment of high-speed voltage regulators has permitted the maintenance of quite good regulation on the supply system. The present tendency is to permit the use of alternators with a voltage increase between normal running and no-load conditions of 12 per cent. General practice is tending to the direct connection of alternators to step-up transformers, instead of to bus-bars. They thus form separate groups of which the total impedance must be taken into account in the case of a short circuit.

As regards (*b*), little experience has as yet been gained in Europe with apparatus for a pressure of over 110,000 volts; as, though lines have been constructed for operation at a pressure of up to 150,000 volts, conditions have not yet called for the maximum. For large capacities, three single-phase transformers are advocated in place of three-phase transformers of equivalent rating. This method facilitates handling of material and, further, a single-phase transformer is all that need be kept in reserve as a spare. The opinion of various operators of transformers is not uniform so far as the advantages for or against earthing the neutral of high-voltage systems are concerned. It is certain, however, that the earthing of the neutral considerably reduces the cost of the transformers. Insulation is, together with the temperature and ability to withstand short-circuits, one of the main factors which determine the life of a transformer. The insulation has to be considered separately between: (*a*) windings; (*b*) windings and earth; (*c*) coils; (*d*) adjacent turns. It is considered that the test voltages prescribed by the French Electro-technical Committee provide an ample factor of safety (*e.g.*, for transformers without an earthed neutral; the insulation test voltage against earth is twice the service voltage, plus 1,000 volts, applied during a period of one minute.)

For transformers of over 50,000 volts and up to 70,000 volts, porcelain insulators filled with resin and oil are preferred on the Continent to plain porcelain. For voltages above 70,000 volts, special bushings either of the condenser or oil-filled type are employed. Oil cooling is exclusively utilised.

The transformer cases are provided with breathers containing air-drying chemicals, such as calcium chloride, to prevent the ingress of moisture.

Reference has been made above as to the difference of opinion that exists as regards earthing the neutral, and it may be remarked that direct earthing (*i.e.*, without a resistance) is now the accepted American practice. The Swiss and Germans prefer to earth the neutral by means of reactances having an inductance value which corresponds to the capacity of the system. Many other prominent European engineers are coming round to American practice in this direction, as regards e.h.p. lines, so the majority vote seems to be in favour of earthing.

Large transformers of very high secondary voltages are generally constructed with the low-voltage winding delta connected, and the high-voltage winding star connected.

With such a big field to cover, but little time could be spared for the discussion of switch and relay design. Further, these details do not seem to attract the interest that is roused over the main problems of design. Oil-break switch-gear seems to be the greater favourite, though the condenser type has many adherents. The Merz-Price system of protection is very favourably spoken of by Continental engineers.

Open-air sub-stations are arousing considerable interest at the present time. They first appeared in the United States about 1912, and in Europe in 1917. The factor that seems to decide whether this system should be adopted or not, is really one of capacity and pressure. Large capacity and e.h.p. stations would seem to be preferable if constructed on the open-air system, especially where land is comparatively cheap. The cost of the apparatus is increased by about 5 per cent., owing to the extra requirements to ensure waterproofness; on the other hand, the overall cost of the installation may be as much as 15 per cent. less than if an orthodox building were constructed. In snowy situations trouble is sometimes occasioned by snow, and in cold situations, special transformer oil has to be employed with a freezing point of −25 deg. C.

Not much time was given to considerations concerning the

*Elec. Rev., December 2nd, 1921; p. 739.

difficulties associated with the parallel operation of stations. There was, however, a strong plea for co-operation between the owners of the stations for their mutual benefit and assistance. This argument seems to have taken effect of late, and it is now quite a usual thing for Continental municipalities to put aside their special jealousies and fall in line with what is, after all, but reasonable procedure, which tends to a reduction of capital and to greater surety in service. In connection with this subject, a very masterly paper was read by Mr. Bakker (The Hague) summarising the investigations of Dutch engineers on the subject. The general argument was developed mathematically in a very interesting manner.

(To be concluded.)

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Western Centre.

Mr. A. C. McWhirter, chairman of the Centre, delivered his inaugural address at Cardiff on November 7th, in the course of which he says: During its, as yet, short existence, the Western Centre has made good progress; commencing in 1912 with a membership of 213, we have now reached the very satisfactory total of 421. Nevertheless, there are many electrical engineers in this district not yet members, who are eligible for admission into one or other of the various grades. Our Centre is increasing its activities each year, and I would suggest dividing the Centre into two, with the Bristol Channel and the River Severn as the dividing line. This would allow a greater number of meetings to be held in the West of England and Wales, and would certainly stimulate local interest in the Institution meetings.

With regard to labour problems Mr. McWhirter says: Surely it is not beyond the wit of man to devise a scheme of arbitration which will avoid trade upheavals? Wages, in many industries, are regulated by the Board of Trade returns. It is a hard economic fact, however, that the cost of living will not fall until wages are decreased. The alternative to decreased wages is increased production, and if we are to maintain our position as an export nation we must increase our daily hours of work. We shall be forced back to our pre-war hours of labour, and I am sure that with very little extra effort the total production can be doubled. We must not wholly blame the workers for their "ca' canny" policy, for it is an acknowledged fact that the majority of the more intelligent and highly skilled craftsmen take little or no interest in the affairs of their unions, with the result that these organisations are not conducted in a manner beneficial to the industry generally and the workers in particular. A much broader outlook is required in trade union matters, and it is the duty of employers and all others in authority over labour to encourage their good workers to interest themselves in the affairs of their union much more than they have in the past. From my own experience of district and national councils for the electrical contracting trade, the feeling of confidence is growing stronger at each meeting, and a very marked difference can be observed in the attitude even of the extremists. The Whitley scheme is good, but it does not go far enough, for we have had instances of the finding of one district council entirely upsetting those of another council in the same district.

The Electrical Contractors' Association is hopeful that in the near future contractors will be required to be registered, and I believe that our Institution would welcome and support such a reform. The Institution would possibly be the body authorised to issue, by examination, the necessary licence. In reviewing the position of the contractors, it is necessary to consider the question of supply authorities which possess trading powers. While it is often the case that such a department can undertake the work for a low price, it must not be assumed that this is a proof of efficiency; more often it is merely a matter of accounting. I am absolutely opposed to municipal trading.

Commercial development is a matter which is exercising the minds of many of us just now. Success can only be achieved by adjusting and co-ordinating all the forces in the electrical industry with a view to fashioning an efficient business-getting machine. The present lack of system, under which few manufacturers consider any interests other than their own, is largely responsible for the discontent which is manifest in every direction. The manufacturers should meet and discuss with the wholesalers, retailers, and large users, suggestions which would assist in producing efficient apparatus at a price which would tempt the user to purchase. The supply authorities should devote attention to reducing the cost of power to a point which will make it a necessity to every one on their mains. They should evolve a scheme, either alone or in conjunction with manufacturers and contractors, to hire out the more expensive apparatus. The wholesaler should carry sufficient stock for all the usual requirements and keep in touch with the newest and best appliances. These he can introduce to the retailer and contractor, who in turn should assist by interesting the user. Many contractors do not realise how much they can do towards the development, not only of their own businesses but of the whole electrical trade. Few consumers make the maximum use of their power and lighting installations simply because they do not realise the possibilities of electricity. By pointing out new uses, the contractor will help the consumer in the efficient running of his business; at the same time he will be promoting the sale of additional appliances with consequent benefit to the manufacturer, the wholesaler, and himself.

The technical training of apprentices is an urgent problem. Restricting the period of instruction to the evening hours is quite unsuitable for the average boy; apprentices should receive a part time training during the day of not less than one whole afternoon a week, devoted entirely to technical instruction. With the assistance of our Technical College, part time training was started in Cardiff last session, and the results have been highly satisfactory. It is the duty of every employer to see that the electrical profession will be composed of well trained craftsmen who will do us credit—we must not forget that these boys will some day form part of their trade union and possibly become leaders. Many firms—particularly those engaged in repetition work—flood their factories with apprentices and employ proportionately few journeymen, to keep down production costs. It is, however, impossible for these firms to absorb all the lads when they have completed their apprenticeships. They are thus thrown on the world with a very inferior training, for it is well known that factory trained apprentices do not receive an all-round experience.

The time has now come to standardise certain dimensions of electric motors and generators—particularly the small and medium sizes. The multiplicity of types in carbon brushes and brush-holders is another continual source of annoyance and expense. Standardisation could be successfully carried much further than is at present attempted.

We, in common with other industries, are undoubtedly passing through the most critical period in our experience. Many well informed critics are of opinion that the present depression in the trade of this country will continue and possibly increase during the next three or four years. I do not believe anything of the kind is inevitable in our business provided we can institute a new and better spirit in our work, and I am optimistic enough to hope that before my term of office has expired, we shall have passed the bottom of the curve of trade depression.

Discussion.

Mr. W. A. Chamen considered that standardisation must be adopted by all manufacturers if real economic progress was to be made. New housing schemes were adopting electricity for domestic purposes, and wall plugs, switches, &c., should be standardised in order to effect interchangeability. He agreed with Mr. McWhirter's views on labour. A way must be found of pulling together; only by so doing could things be put right.

Prof. Knox was keenly interested in the remarks appertaining to the training of apprentices, and the scheme introduced at Cardiff. Considerable opposition had been offered to similar schemes in Lancashire, not only by the employers, but also by local education authorities and the workers. The trade unions had no interest in their members being trained technically. The employers could not see the sense of it. In Germany in 1913 there were 188,000 in the higher technical classes taking full time day courses exclusive of those at the universities and university colleges; in this country the number of students attending technical institutions and University colleges was 2,784.

Mr. R. H. Alger considered that power companies and municipal authorities had to look for their load largely in the homes of the country, and it was up to the contractor to make widely known the apparatus that could be used in the home. Contractors had not received in the past the support they should have from the supply authority side. He agreed with the remarks regarding municipal wiring; it did not pay.

Mr. Plevin agreed that the return of good trade conditions could only be obtained by the co-operation of both sides. He was told that the wages of the labourer was 35s. per week at the present time. He refused to believe that that was adequate remuneration for any man.

Mr. Rogers said that the proper training of apprentices appealed to him, as it always seemed to him that the electrical fitter never had a proper mechanical training. Regarding the splitting of the Centre, he was sorry the suggestion had been made. It was possible that South Wales would benefit, but the West of England would suffer.

Prof. Bacon said the division of the Centre was a matter on which finality ought to be reached. Facilities should be afforded the Plymouth members for attending meetings, and alternative meetings could be held at Bristol and Exeter.

Mr. Burr agreed with the sentiments of Prof. Bacon regarding the division of the Centre. As regarded municipal trading he was at variance with Mr. McWhirter. Municipalities should have showrooms. In Swansea they had an understanding with the contractors which worked quite satisfactorily, inasmuch as it saved the contractors the trouble of equipping showrooms.

Mr. Hughes said standardisation was of supreme importance in connection with an electrically-operated colliery.

Mr. New reminded Mr. McWhirter that, generally, muni-

cipal trading accounts were carried out by another department. Co-operation from the Contractors' Association was necessary if costs were to be reduced.

Mr. Stretton considered it would be to the advantage of all concerned if two distinct Centres were created. More co-operation between the various sections of the industry was needed.

Mr. Teasdel alluded to municipal wiring, saying that the financial view taken by Mr. McWhirter was impossible. He admitted that contractors could do the work cheaper, nevertheless people came to municipal authorities feeling more secure of getting a sounder job; for this privilege they were willing to pay an extra pound or two.

Major David considered the standardisation of motors was of the utmost importance.

Mr. S. T. Allen said the suggestion of splitting the district came as a great disappointment to him.

Mr. Evans said he confirmed what Mr. Teasdel had said regarding municipal wiring. If Mr. McWhirter's suggested registration of contractors came about, it would matter little whether the work was done by the contractor or the authority.

Mr. McWhirter in reply said, regarding the splitting of the Centre, that they had to consider Swansea. The meetings already held there were most encouraging and their enthusiasm was great. Finances would not permit of Swansea being a sub-centre. He agreed with the remarks of Prof. Knox. Municipal showrooms could be worked satisfactorily both to the authority and the contractor, provided the authority did not pinch all the trade. The whole point in dispute was what was a fair profit to the authority and the contractor, when a customer was introduced by the latter?

OIL ENGINES AND ELECTRICITY SUPPLY.

By G. PORTER, A.M.Inst.C.E.

(Abstract of paper read before the Diesel Engine Users' Association.)

The discussion that was promoted by Mr. Geoffrey Porter's paper on the function of the heavy oil engine in connection with the general supply of electricity, at the October meeting of the Diesel Engine Users' Association that was held at the Institution of Electrical Engineers, was opportune in view of the consideration that is being given by the Electricity Commissioners to various schemes for extending and improving the general supply of electricity throughout the country. The author submitted interesting figures of tabulated working costs, including capital charges, of undertakings using steam plant, or heavy oil engines, or a combination of both, and in each case he showed the permissible purchase price payable for a bulk supply from an outside source. Curves showing total transmission losses of various mean loads and power factors, permissible purchase prices, costs per kWh of alternative methods of operating, &c., accompanied the paper. There were also appendices giving particulars of Diesel engine performances at actual undertakings, heavy fuel oil engine consumptions, examples of terms offered to local supply authorities for bulk supply, and the estimated costs of a power station employing heavy oil engines. Although there was naturally considerable difference of opinion with regard to the merits or demerits of various systems of providing for a supply of electricity in an area under varying conditions, it was generally admitted that there could be no case for *complete bulk supply*—that is, for a system of supplying in bulk throughout the country, which would entirely eliminate local generating stations of comparatively small power, and that there was a very strong case for the installation of heavy oil engine plant so long as a good supply of suitable liquid fuel could be ensured. One speaker, who had had experience in connection with about forty electricity supply undertakings equipped with Diesel engines, gas engines, steam engines, and steam turbines, some of which were taking bulk supplies, referred to the very large number of cases in which no bulk supply could compete with the local generating station. He felt, as others did also at the meeting, that bulk supply should be made use of wherever possible, and even perhaps in certain cases in which at the moment it might not be the most economical way to meet the immediate needs of an undertaking, but that every case must be considered on its own merits. He added that he had no doubt that the Electricity Commissioners would be approachable and willing to hear all sides of any question of this sort, and he felt certain that, after the experience which the Commissioners had obtained during the past year, they would now understand the many difficulties and limitations of bulk supply, and that anyone with a good case for local extensions of generating plant would get a fair hearing.

Mr. Porter's statements concerning the great development of the oil supply industry and the ample proportions of the oil reserves in the world were emphasised by several speakers. Reference was made also to the possibility of oil being distilled from coal on a larger scale in the future, and to the successful operation of Diesel engines during the war period on tar oil. The consideration of the use of heavy oil engines to an increasing extent in the future was closely bound up with the development of larger units in which so much progress had been made for marine work during the last few years.

In the course of his paper Mr. Porter says, *inter alia*:—The dimensions of the problem of the future production of electricity have been brought within their practical limitations, and it appears probable that the improvement of electrical distribution will be sought along the lines of development of the best existing resources. Further capital expenditure on a large scale must be most carefully applied if the means adopted are not to defeat the desired end.

It is not suggested that the heavy oil engine is the best form of prime mover to employ in any and every situation. For the present he confines its adoption to undertakings of moderate size where the industrial demand is not large, and where units not greater than 1,000 kW can be confidently adopted. The conservation of fuel must be the guiding principle, and the use of coal for purposes other than steam raising is foreshadowed. The power production of the future appears to lie between fuel oil and coal gas, and the superior portability of oil will be a strong factor when the desirable features of either are equated. The production of mineral oil is increasing very rapidly. Its transport from overseas becomes a simpler problem month by month, and there is every indication that the supply will keep pace with demand. The Diesel engine is in active and successful commercial application in capacities up to 6,000 b.h.p., and ratings of 1,000 b.h.p. per cylinder. The manufacturers of these large capacity engines are prepared to build an 8-cylinder engine up to 10,000 b.h.p., and have actually constructed a satisfactory experimental engine of 2,000 b.h.p. in one cylinder. One of the most promising directions in which progress is moving is the opposed piston construction. Much larger capacities per "line" are available with this type than are usual in the ordinary design of Diesel engine. Even more promising is the heavy oil engine of the regenerative type invented by Mr. W. J. Still, in which the highest known thermal efficiencies are achieved. The flow of heat is so admirably controlled that there seems no reason why very large powers should not be obtainable. The conditions are such that cylinders may be rated much more highly than is at present possible in engines of the ordinary Diesel type. A 6,000-b.h.p. cylinder is said to be a practicable possibility. This engine has also been designed as an opposed piston engine with good results. Briefly, the heavy oil engine is obtainable commercially in capacities up to 6,000 b.h.p. without undue multiplicity of cylinders. Such a capacity will be sufficient to drive an electrical generator of from 3,500 to 4,000 kW.

From the point of view of the power station engineer the paramount advantage of the steam turbine is its capacity to concentrate great powers in comparatively small bulk and weight. The influence of this property upon capital cost has been, until recent years, great enough to outweigh the comparatively low thermal efficiency of the steam cycle, from coal handling plant to generator coupling. The internal combustion engine must show thermal efficiencies so good that high capital cost is no disadvantage. In general this condition is satisfied.

The capital costs of the steam and heavy oil engine power station are at present roughly in the ratio of 5 to 7. This proportion stands for the 4-stroke cycle Diesel engine and the steam turbine with boilers and auxiliaries. For Diesel engines of the 2-stroke cycle the ratio is about 5 to 6. And for the smaller capacities dealt with by the semi-Diesel and other oil engines the proportion is about 2 to 1.

On the operating side the position is wholly in favour of the heavy oil engine. An average thermal efficiency of a steam turbine power station of 15,000 kW operating at a 20 per cent. load factor is from 7 to 8 per cent., and the heat expenditure per kWh lies between 40,000 and 50,000 B.th.u. The highest contemplated overall thermal efficiency under ordinary operating conditions and at load factors exceeding 50 per cent. is not above 20 per cent., and the more usual efficiency of from 7 to 8 per cent. corresponds to an energy production of from 500 to 600 electrical units per ton of coal burnt.

Thanks to the economy of the heat cycle adopted, the heavy oil engine provides infinitely better results for a tithe of the trouble. In quite small power stations there is no difficulty whatever in obtaining overall thermal efficiencies of from 25 to 29 per cent. under ordinary operating conditions. The heavy oil engine is not so sensitive to load factor as the steam turbine or engine. In engines operating at 65 per cent. plant load factor one ton of residual petroleum fuel oil will produce 3,300 kWh for a heat expenditure of 12,500 B.th.u. per electrical unit.

In many instances it must be more advantageous for the local electricity supply authority to generate locally, using heavy oil engines, with the benefit of their high efficiency reflected in the operating costs, than to purchase in bulk from an external authority producing energy by less efficient means and transmitting for local distribution from a distance. The indifferent efficiency of production is aggravated by the inevitable loss in the transmission system, a loss that must be

considered in fixing the purchase price, and will fall upon the local distributing authority.

The reply to this criticism is always in terms of load factor. In some miraculous way the bulk supplier's best possible efficiency of about 20 per cent., reduced to a mean of about 12 per cent. at the purchaser's switchboard, according to distance, will enable him to compete with the 27 per cent. (a low figure) efficiency the prospective purchaser can obtain by continuing to generate locally with the heavy oil engine.

Will the 50 and 60 per cent. load factors so frequently mentioned as the bulk suppliers' perquisite be realised, except in a strictly industrial district?—and even here the tendency towards shorter factory hours may have a detrimental effect. In a neighbourhood where the industrial demands are small the bulk supply authority will probably develop a peak load corresponding to the sum of the peak loads of the individual local distributing bodies. The price of a bulk supply under such conditions might readily be prohibitive.

An equally important consideration with regard to bulk supply is capital cost. A wholesale scrapping of sound, even if inefficient, plant would involve a great waste of existing assets. Whatever may be the inducement to purchase in bulk, the abandoned assets and their annual burden on the funds of the local undertaking cannot be got rid of. The crux of the matter is not so much what price the bulk supply authority will charge for energy, but how much the local distributor can afford to pay without prejudicing the interests of his consumers.

The purchase of the whole or part of the requirements of a local supply authority is not justifiable on economic grounds. It is less expensive for the local body to generate locally, and by doing so with the use of the heavy oil engine as the prime mover the interest of the consumer is safeguarded.

There are fashions in engineering matters just as in other worldly things, and fashions are very difficult things to withstand. At present we have the fashion of the "big set" swollen to such proportions that its habitat is too small for its activities. Many small and medium undertakings will further their interests much better by adopting a fashion more suited to their conditions, in the form of the heavy oil engine.

TELEPHONE LINE WORK IN THE UNITED STATES.

Discussion at Newcastle-on-Tyne.

At a meeting of members of the North-Eastern Centre of the Institution of Electrical Engineers, at Newcastle-on-Tyne, on November 14th, Mr. E. S. Byng read his paper on the above-named subject (see Elec. Rev., November 25th).

Mr. J. R. M. Elliott, in opening the discussion, said the author's information was possibly that for which many of them had been waiting for some time. The climatic conditions existing in this country were so different from those in America that it had generally been regarded as necessary to have a higher standard of constructional development for English plant, and what had been shown on the screen seemed to bear that out. Before the war the record of the U.S.A. with regard to the use of mechanical appliances was very good, especially in connection with the construction of line work and cable laying. The use of those appliances had been developed, but he had hardly been prepared to hear the records that the lecturer had submitted. One factor that must have contributed largely to the development of those mechanical appliances was the low cost of petrol, but that was no reason why they should not try the experiment of making use of some of them and ascertain the relative costs compared with America, but it must not be forgotten that the cost of production was a vital factor. In America the cost of petrol and machinery was low, and charges for wages and salaries were high; generally, the reverse was the case in this country, so that one could not jump to a conclusion as to the effects of such a change of methods. Regarding the use of American technical terms and words, he thought the author would have done well had he appended a glossary of them and their English equivalents. Passing on to details, regarding the possibility of manufacturing and using a No. 27 B and S gauge cable (3¼ lb.), he did not think there would be any difficulty in drawing it, but in other operations there might be a tendency to break, and there might be a difficulty in jointing. He would not care to have h.p. lines mounted on poles bearing telephone wires. In this country motor-cycles, with adapted side-cars, were found most useful. There had been in contemplation the construction of a 3-ton lorry, fitted for constructional purposes, but the difficulty had been to carry ladders suitable for their requirements.

Mr. G. W. Willis thought American engineers showed great foresight in making provision for development. The American nation had shown great perspicacity in its use of the telephone, and if the telephones in this country were supported by the public as was the case in the States, then they could make a much better show. They seemed to have a lot to learn from the Americans, but, at the same time, much of their work appeared to be very rough and crude. Were there no mischievous boys in America?—because the plant was so close to the ground that it would not last a week in England. He imagined that the reason that there were not frequent break-downs of line was that the span of the lines was so short.

Mr. Vernier had no idea that cables of the size mentioned had been erected as aerials. The problem with which he had to deal was different from that of the post office, to which reference had been made; it was to carry telephone cables on overhead transmission lines, and they devised a system of hangers of leather with a clip which had proved quite satisfactory.

Mr. F. G. C. Baldwin said that while it must be admitted that the telephone had been developed in America by a high standard of technical skill and commercial enterprise, it should not be forgotten that a good deal of pioneer work was done here. He had been under the impression that the us of antimony as an alloy with lead for cable sheaths was experimented with some years ago, and that in view of the tendency to brittleness which the use of antimony engendered the matter had been dropped. That difficulty had apparently been got over. The advantages of aerial cable that Mr. Byng mentioned were much more applicable to American conditions than to British ones. During the period from 1900 to 1911 a large amount of dry-core lead-covered cable was erected in this country. A good deal of it had been recovered, and examination revealed the fact that even the comparatively soft pig-skin slings had caused serious indentations in the lead, and incidentally that crystallisation of the lead sheath appeared to be fairly general. He was particularly interested in the method described for leading-in cables at exchanges; it was certainly flexible. So far as he knew the leading-in arrangements adopted at the Victoria Exchange in London were superior to any that had hitherto been employed in this country. Instead of carrying the cables along the walls of the chamber they were carried along an iron racking running from end to end of the cable chamber beneath the main frame, and provision was made on the rack for any necessary crossing of cables. Referring to the boiling-out process in conjunction with woven-cotton sleeves, he was not satisfied personally that the process was all that was claimed for it. His experience had not been that superior insulation could be absolutely relied upon by the adoption of that process in preference to any other. The reason was not apparent, but was probably due, either to a lack of appreciation of the requisite temperature, or to want of experience on the part of the jointer in applying the wax.

Capt. Gascoigne, referring to the statement that 1,500 pairs of wires were included in one cable, suggested that that number was, possibly, too great because of the serious trouble in case of breakdown.

Brief remarks were also made by Messrs. Simpson and Gilpin.

The Cost of Wiring Installations.—In the course of inquiries made by Mr. Scott Moncrieff in connection with the work of the Electrical Development Association on unemployment in the electrical industry, he ascertained that there was a strong feeling amongst wiring contractors that a reduction in the cost of wiring would result in a material stimulation of business with a corresponding reduction of unemployment. Opinions differed as to the reduction necessary, but it appeared to be generally agreed that from 20 to 33 per cent. would go a long way towards inducing potential customers to have their premises wired. Many of the latter were anxious to obtain a supply of electricity, but were definitely holding back on account of the high prices current. A few contractors held that a reduction of 50 per cent. would be necessary to bring about the desired result. Where the cost of wiring was round about 35s. a point, business was dull, but where the price was 25s. to 30s. a point the contractors were fully occupied, and all new premises were being connected to the mains, whilst some were being changed over from gas lighting. It was pointed out that the cost of labour was the chief obstacle, and that a fair proportion of the desired reduction should come from that quarter. "Small men," who did their own wiring, could quote lower prices than the larger contractors, and were getting work to do, whilst contractors were reducing their staffs. The high cost of motors was also deterring would-be power consumers from adopting electricity. Another adverse factor was the cost of laying distributing mains. The reduction that had already taken place in the cost of wiring had materially improved the demand for connections.

Photographing London by Night.—Messrs. Pathé Frères, the well-known kinematograph firm, have taken the first of a series of night photographs of London buildings and monuments. The apparatus was mounted on four lorries. Two of these bore generating sets, and two carried three 1,000,000 c.p. "Sunlight" arcs each. Among other edifices photographed was the tower carrying "Big Ben."

"CYC-ARC" AUTOMATIC ELECTRIC WELDING.

By L. J. STEELE, M.I.E.E., and H. MARTIN, A.M.I.E.E.

(*Abstract of paper read at the* Institution of Electrical Engineers.)

The problem of welding electrically by direct means two pieces of metal of widely different sections has hitherto remained unsolved, and the welding of dissimilar metals of widely different melting points, such as brass and steel, has been considered impossible. The "Cyc-arc" process of automatic electric welding has, however, solved these problems, and it is believed that the system (which has already been illustrated and described in this journal*) is unique on account of the fact that metals, differing both in size and quality, can be automatically welded together as the result of a single operation of an ordinary bell push, by the consequent heating of only the metal parts to be welded, without using an electrode or any flux.

The process was developed to save labour when attaching small screws or studs to ships' plates to carry the supporting clips of electric cables and fittings, and the advantages of doing so without perforating the bulkheads or decks is obvious; it is the only known successful method of doing so. In 1918 a light magnetic stud holder was constructed to retain the stud accurately in position upon the iron or steel plate while it was being welded thereon, thus eliminating one operator. Instructions were then received at Portsmouth Dockyard from the Admiralty that apparatus should be made in accordance with proposals submitted (by members of the dockyard staff) of what was named a "semi-automatic device for stud welding." This apparatus, which was intended primarily for the welding of iron or steel studs or screws to iron or steel plating, consisted of a pair of pot magnets supporting, but insulated from, a stud holder attached to a plunger, the latter being movable against the pressure of a spring, and fitted at one end with an insulated striking knob. The apparatus was to be fixed in position for the stud to be welded by simply energising the magnets. Then, with the spring holding the stud out of contact with the plate, it was intended that the knob at the end of the plunger should be struck to overcome the action of the spring, momentarily bringing the stud in contact with the plate, and also closing the welding circuit. The stud, after momentarily touching the plate, would be released and at once forced out of contact by the action of the spring, thereby drawing an arc. After an interval of time the molten stud was to be forced against the adjacent molten plate by again pressing the knob of the plunger, thereby welding the stud to the plate, the current in the main circuit through the stud, weld, and plate, being finally switched off. The three variables which had to be correctly adjusted in order to obtain even apparently satisfactory welds were: the amount of current through the arc, the length of the arc upon striking, and the length of time it had to be maintained before making the weld. Obviously, one or more of these factors must vary for every different size, shape, and material of stud and, in view of the extremely short time during which it was necessary to maintain the arc, it was found that considerable accuracy in all the above three factors was necessary to secure even moderately good results, and an automatic timing and control system yielded important improvements in uniformity in the resulting welds.

The necessity of centralising the arc as much as possible throughout the entire period of operation, and also the desirability of forming an enlarged crater of molten metal in the plate into which the stud end is to be inserted have been met by the use of a ball-ended stud. The length of arc that is just sufficient to enable the arc to be uniformly and reliably struck and maintained is 1/16 in. The means of effecting the desired adjustment at the welding tool is shown in fig. 1. The method is simply to screw down the adjusting head (35) until the plunger (36) just comes into contact with the solenoid core (31). As the plunger (36) projects beyond the adjusting head (38) by exactly 1/16 in. this will determine the exact length of arc which is struck when the solenoid is energised. A limiting device (29) indicates when it is necessary for the position of the solenoid and accessories to be adjusted relative to the plate by means of the adjusting screws and nuts (1) and (6).

In consequence of improvements, completely successful results, both in operation and in welding, were achieved, and welds thus obtained exceeded our best anticipation, both in quality and in uniformity. It was in fact found, as the result of careful tests, that the strength of the weld actually exceeded that of the stud itself.

Although for a long time after success was obtained we believed this welding process to be entirely new, we have since found that the fundamental method was discovered and presumably used in about 1890, but with hand instead of automatic operation and control of the time-period of the arc. It is evident, therefore, that the application of automatic timing by means of electrical control is the principal feature of our invention, the lack of which feature prevented this effective welding process from being developed and utilised at least 20 years ago.

Additions to and modifications of the apparatus, were next made by means of which the timing apparatus was started and stopped, and the whole sequence of operations required to make a weld effected by simply pressing an ordinary bell-push attached to the welding tool. This important improvement, though really of quite a simple nature, is best understood by reference to fig. 2.

The difficulties in welding steel and iron studs, as compared with those made of naval brass, at this stage of development necessitated further experiments with a view to finding some method or apparatus which would satisfactorily weld such studs. However, satisfactory welds of the type in question can only be secured by returning the stud to the plate under powerful and sustained pressure, and we therefore designed a tool which returned the stud to the plate under the action of compressed air admitted into a cylinder, the piston of which was attached to the stud-holder of the welding tool.

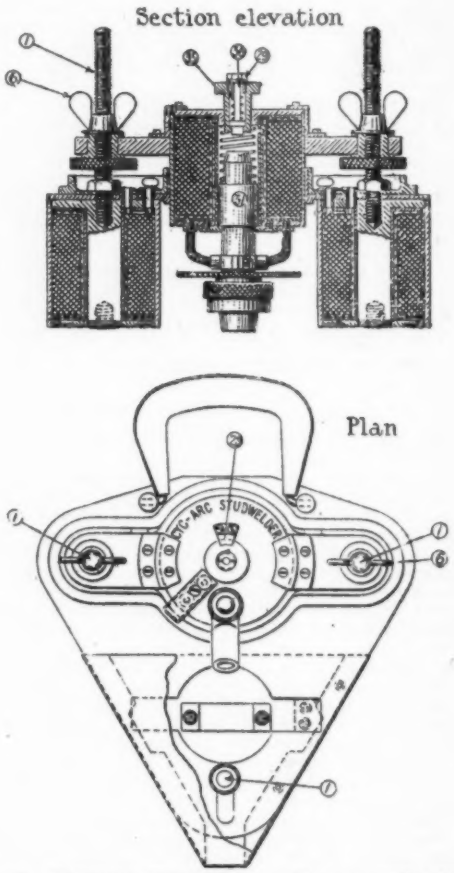


Fig. 1.—Sectional Elevation and Plan of "Cyc-Arc" Welding Tool.

which showed that our theories were correct, and that satisfactory welds of steel or iron to other metals could be obtained with it.

We have since classified the two kinds of welding apparatus as Type A and Type B, the former being essentially a portable type, having a welding tool provided with hold-on magnets and spring replacement of the stud-holder plunger, and the latter being a fixed or shop-tool type, the welding tool being attached to a slidable spindle, such as that of an ordinary post drill, and being connected to a compressed-air supply through an electrically-operated valve, in order to replace the stud against the plate under air pressure.

Our latest form of timing and control apparatus, common to both the above-mentioned types of apparatus, is driven by means of a very powerful, double-spring motor, has a gravity-loaded vertical plunger contact for its main involute cam, and is provided with a uniformly divided and clearly marked timing dial and accessories, which can be simply and instantaneously adjusted to ensure that the apparatus will accu-

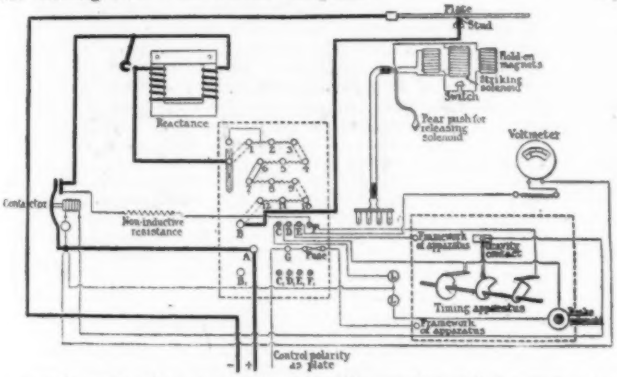
* Elec. Rev., September 30th, 1921; p. 432.

rately maintain the arc for any period of time between 0.1 and 3.0 seconds, variations of 0.01 second being readily obtainable. The simple and accurate time adjustment is secured because the rotation of the marked dial causes the rotation of a spindle, to one end of which is attached a cam, which regulates and limits the lowest position of the main plunger contact of the apparatus relative to the main involute cam. The cam in question being of similar shape to the main involute cam, if the main plunger contact is normally allowed to drop to a low position, it will make contact with its own involute cam proportionately earlier than if retained normally in a higher position, thereby increasing the arcing period. In its upper or zero position, although, as the result of the operation of the timing apparatus, the main contactor closes momentarily, the arc-striking solenoid is not energised, for the simple reason that the stud-holder solenoid is short-circuited at the moment the contactor control-coil circuit is closed.

This improved timing and control apparatus has so far quite justified itself. The period of each complete rotation of the cam spindle of this improved apparatus is 7 seconds. In cases, however, of the use of the "Cyc-Arc" apparatus continuously and rapidly on one particular class of job which requires a practically uniform time period, a much cheaper and simpler timing and control appartus can be provided, so designed that, instead of each operation of the timing apparatus occupying a 7-second period, the arc strikes practically instantaneously when the push-button is pressed, the total time period of this form of direct-acting timing device being practically the same as that of the arc.

About 400 welds can be made with the timing device without re-winding it.

The Type A portable apparatus, as now constructed commercially, consists of two main parts, viz., the controller and the welding tool. The former comprises:—



A = main supply cable; B B_1 = terminals for cables carrying welding current; C D E F C_1 D. E. F_1 = sockets for 4-pin plugs; G = terminal for control wire; L = lamp resistance; 1-12 = terminals for regulation resistances; S = brake solenoid.

Fig. 2.—Connections of Portable Welder.

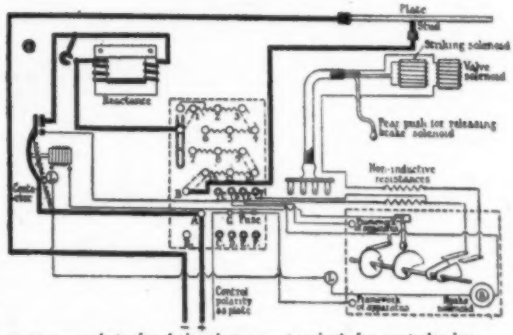


Fig. 3.—Connections of Electro-Pneumatic Welder.

(1) Automatic timing and control apparatus. (2) Marble connecting and regulating panel. (3) Adjustable reactance. (4) Non-inductive resistance. (5) Carbon-filament lamp resistance. (6) Resistance coils for current regulation, with supports and insulators. (7) Automatically-operated electric contactor. The nichrome resistance coils may be arranged either in series or in parallel, or practically in any combination thereof, so that large variations, both in the current-carrying capacity and in the ohmic resistance of the coils, can be obtained, thus permitting of a wide range of adjustment for welding purposes. To supply a controller for much larger work the only modifications necessary in the standard controller are the substitution of a contactor of greater capacity and an increase in the size of the main connecting leads. Provision is made for the connection of two welding tools if it is desired to double the output of a single-controller set, which two tools are operated on our dual-control system. Fig. 2 shows the connections of the commercial Type A apparatus, which is designed for operation from ordinary direct-current welding supply mains, and only very slight modifications are necessary to make it suitable for any voltage between 60 and 100. The normal current-range is from 200 to 500 amperes, according to the size of the stud or other fitting to be welded. The actual energy consumed per weld, however, is extremely small, the usual duration of the welding current being about 1 second.

The apparatus will satisfactorily weld naval brass or manganese-bronze studs of good quality up to ½ in. diameter on to brass, manganese-bronze, iron, or steel of practically any thickness, and also on to galvanised iron or steel. Once the apparatus has been set up for a particular size of stud or fitting its operation is practically automatic, and it can be worked by semi-skilled labour.

The operations necessary for making a weld (after the controller and the surface on which the weld is being made have been connected to the supply mains) are as follows: the stud or other fitting to be welded is first placed in the holder of the welding tool, and the latter is secured in the desired position by means of the hold-on magnets. The arc-limiting device is then set, after which a single action of the bell-push starts the timing and control apparatus, thereby making the welds. The cams of the timing and control apparatus stop automatically in exactly the same position relative to the contact fingers as that from which they started. The weld having been made the tool is removed from the surface (to which it is attached by the magnets) by opening the tumbler switch and withdrawing the tool from the stud, which remains welded in position.

The welding tool can be taken to any position where the work has to be performed. The entire equipment can be transported by two men, the welding tool itself being readily and conveniently handled by a single operator, its weight being under 20 lb.

The value of the current required with a given time-setting depends to a certain extent upon the time during which the arc current is maintained, and *vice versa*, but there is a substantial range for adjustment, throughout which range no seriously deleterious effects on the welds need be anticipated. The approximate range of arc-current adjustment is between 200 and 500 amperes, with a 100-volt supply. Currents of air (such as those in draughty passages) may cause the welding arc to be blown to one side, if not actually extinguished. The hold-on magnets of the welding tool are provided with an adjustment to allow of the tool being readily adapted and fixed to uneven or curved surfaces.

A fixed type of welding tool has recently been constructed for use with the type A apparatus to fit any kind of light post-drilling machine. This adaptation already promises to have a wide field of application in engineering shops for light work.

The Type B electro-pneumatic set also comprises the controller and welding tool with arrangements for the supply of compressed air. The welding tool, fig. 4, consists of a combined solenoid and air cylinder that is intended to be attached to, though insulated from, the spindle of a drilling or other suitable machine, which has to be sufficiently rigid to withstand the powerful thrust exerted by the piston of the welding tool when subjected to the maximum air pressure which can be supplied. The size of welding tool shown will deal with work requiring currents up to 1,500 amperes, and for electricity supply purposes a motor-generator such as that described later will be used.

The air-supply required careful consideration, because the quantity needed is so small; the maximum amount of compressed air required per minute will be less than 0.05 cu. ft. The compressor is of the motor-driven tire-inflator type, which keeps fully charged an air receiver interposed between it and the welding tool, the maximum pressure being 150 lb. per sq. in.

Fig. 3 shows the connections of the Type B apparatus.

The use of the apparatus, modified to operate on the dual-control system, enables its output of work to be doubled, with only about a 25 per cent. increase in the cost of apparatus, and without any appreciable increase in the size or cost of the welding supply plant. The single controller is fitted with a pair of solenoid-operated discriminating switches, as well as with an additional contactor, non-inductive resistance and accessories, as compared with a controller for a single-operator set. The discriminating switches, which are operated by the ordinary action of the push-button control on the welding tool, permit of a welding operation being effected by only one welding tool at a time, during which operation the other tool is completely and automatically isolated, and thus put out of action. The hold-on magnets of the welding tools are, however, quite unaffected by this arrangement. Owing to the extremely short overall time required to make each weld, viz., 7 seconds, compared with the time taken to remove the welding tool after the completion of the weld, and to replace it in another position with a fresh stud in the holder ready for welding, two operators can use two welding tools alternately on the dual-control system, without delaying or interfering with one another in any way, and thus make double the number of welds possible with a single-operator equipment; this enables two operators to work at the rate of from 80 to

100 welds per hour with the portable apparatus, and at a rate of over 200 welds per hour with the fixed machine adaption of the welding tools.

The successful results obtained are due mainly to the method of automatic control and accurate timing of the cycle of operations, and it has been possible to draw up a table of the adjustments of current and timing necessary for the welding of different sections to varying thicknesses of plates, and also with relation to the welding of different metals. Perfect welds can be obtained between naval brass or manganese-bronze studs, and steel, iron, or brass plates. Equally satisfactory welds are obtained if the iron or steel is galvanised, provided that the zinc deposit is not unduly thick. Surprisingly good and strong welds can also be made with brass tubes on to steel plates, and the latter may be less than 30 mils in thickness. Excellent welds can also be made on to spring steel. When welding brass tubes 3/16 in. in diameter on to steel plates about 0.03 in. thick, the time during which the arc is maintained is only 0.1 second. An action which contributes materially towards the strength of the weld takes place when welding such tubes. The molten brass rises into the interior of the tube at its base and forms a solid section for an appreciable height.

Another valuable application of the process is for the tipping of machine tools. Welds obtained are extremely reliable and satisfactory. It is necessary, however, to anneal the tool as soon as possible after tipping before attempting to grind or work on it in any way.

The great strength of the welds obtained by this process of welding led to the conclusion that this might reasonably be attributed to three causes: (1) Absence of oxides in the weld. (2) Extremely local heating in the region of the weld. (3) Penetration (in each direction) of the metals to be welded. Since then, by the aid of micro-sections at a magnification of 50 diameters, the above conclusions have been definitely confirmed.

It would appear that the effect of heating does not extend for more than 0.5 in. from the weld. There are also indications of a fused mixture on each side of the weld to a depth

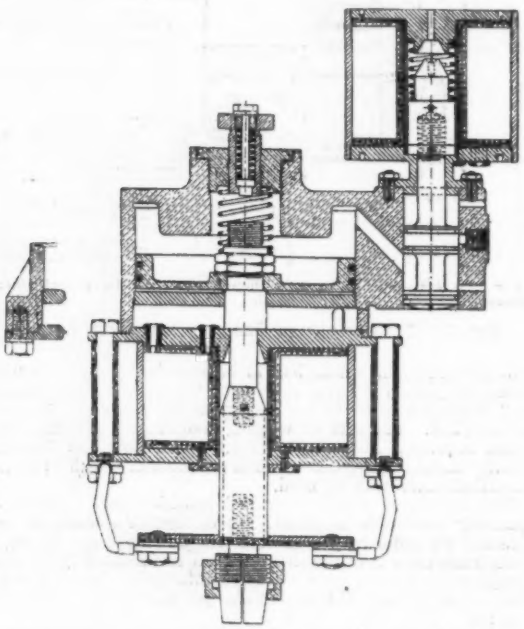


FIG 4.—"CYC-ARC" ELECTRO-PNEUMATIC STUD WELDER.

of about 0.01 in., but not much penetration beyond this. Mechanical tests have shown that plates to which studs have been welded by the "Cyc-Arc" system have actually been reinforced by such welds. Lloyd's Register of Shipping has fully approved of the process for use in ship construction.

Apart from the advantages just mentioned, there is also great economy in time and labour. At least 10 studs can be welded in position in the time occupied in fitting one bolt or screw by the ordinary methods of drilling and tapping, and, with an average run of work, large studs can be welded at the rate of at least 40 per hour. The cost of fixing studs by this method is less than one-quarter that of screwing them by the ordinary method. The fact of the surfaces being wet is not disadvantageous to this process of electric welding; in fact, perfectly satisfactory welds can be made under water.

Particular attention is called to the quality of the welds between brass and steel, iron, or brass, not only as regards mechanical strength, but also electrical conductivity, which indicates a means of making electrical connections of a quality hitherto unobtainable, in a perfectly simple and rapid manner. A striking illustration is all kinds of electrical bonding. It is obvious that, apart from ship construction, electric bonding, &c., this system of welding is capable of application in many industries.

The "Cyc-Arc" process differs from the majority of other welding processes in the fact that each weld takes a relatively heavy rush of current for an exceedingly short time. As, in addition, the supply pressure need not exceed 60 volts, an extremely small quantity of energy is required per weld, *e.g.*, a ¼-in. diameter stud takes 12.5 watt-hours, or 1/80 kWh, while a ¼-in. stud weld takes only 2 watt-hours, or 1/500 kWh.

Although the Type A welding apparatus is being operated satisfactorily direct from the ordinary 60 or 100-volt direct-current welding supply mains on fairly large installations where the supply mains and plant are of considerable capacity, it has, on the other hand, been found necessary to design special supply plant for use in conjunction with the "Cyc-Arc" apparatus.

Where the existing welding supply plant is of small capacity a special "kinetic generator" can be supplied at a relatively low cost. In the intervening periods between welds the machine merely motors "light," but the moment a weld takes place it automatically becomes a generator, supplying practically the whole of the welding load, owing to the combined effect of its flywheel and the special design and arrangement of its field windings. The current taken from the welding supply mains when supplying the Type A welding apparatus through this special kinetic generator need not exceed 50 amperes, while its motoring current when running light is only from 12 to 20 amperes.

The consequent advantages in minimising peak loads on the welding supply plant, and in reducing the size of the supply mains necessary for "Cyc-Arc" welding are obvious.

To meet cases where no suitable welding supply is available motor-generators can be supplied at a cost not greatly in excess of the price of the kinetic generators, because the driving motors are only of approximately 3 kW capacity. These motor-generator sets, when running light from the supply mains, take about 1¼ kWh per hour, this amount being increased to less than 2¼ kWh per hour when welding the largest size of stud at the maximum possible rate with the Type A apparatus. In addition, the maximum load on the supply mains need not exceed 5 kW, *i.e.*, 23 amperes at 220 volts d.c., 11.5 amperes at 440 volts d.c., or 6 amperes at 440 volts a.c., three-phase.

Where no electricity supply is available, the kinetic generator has been adapted for use with small petrol, paraffin or steam engines, and can be also supplied in portable form. The size of engine required for the Type A apparatus is only from 5 to 6 h.p., the average load when welding at a maximum rate being about 2¼ h.p., and the petrol consumption being less than 1 gallon per day of 8 hours, during which at least 400 welds should easily be made.

Direct current is supplied to the "Cyc-Arc" welder under conditions the characteristics of which are unusual, that is to say, in such a manner that the circuit should be substantially devoid of the effect of the inductance of series coils at the moment of striking the arc, while the advantage of cumulative compounding for maintaining the voltage during welding operations is considerable. These objects are achieved by employing a machine comprising a field system, and an armature with two windings and two commutators, each winding being connected to a separate commutator. The brushes of one commutator are coupled in parallel with the brushes of the other commutator to the leads supplying the welder, series excitation being provided by a winding in the circuit of one only of the armature windings, and the shunt winding being conveniently, though not necessarily, excited from the same side of the system. The generator has a double winding, and the common field is so arranged that one winding strikes the arc while the other gives the cumulative compounding for maintaining the voltage during the weld. The arrangement also facilitates self-excitation and maintains a steady supply of current to the solenoids, as well as affording a means of compensation for any drop in speed to enable the flywheel energy to be utilised. The generators are suitable for driving by induction motors having a synchronous speed of 1,500 r.p.m. A cast-steel flywheel is mounted between the motor and the generator, and the drop in speed during a full 2-second weld taking 500 amperes at 60 volts is about 15 per cent. The regulation is based on the assumption that there is a definite period between each weld in which to restore the energy of the flywheel. Any undue increase in the motor load owing to the drop in speed of the machine is prevented by the compound winding of the d.c. motor, or by the use of a slip resistance in the case of an induction-motor drive. The current peak is less than one-seventh of that required by a set not provided with a flywheel.

The Brush Electrical Engineering Co. constructed the first kinetic motor-generator of the above described type. Alternating current will ultimately be used, more particularly in welding considerably larger work than it has hitherto been possible for us to undertake. There are, however, difficulties to be overcome in order to obtain satisfactory "Cyc-Arc" welds by means of an a.c. supply owing to the uncertainty of striking an alternating-current arc. Satisfactory means have, however, been evolved for overcoming these difficulties, which it is not proposed to discuss at the present time. However, we consider that it will be generally advan-

tageous to use d.c. for small work, and that it will probably be worth while constructing the modified apparatus necessary for use with a.c. only when using currents of well over 1,000 amperes.

It will probably be a matter of some surprise that reference has been made so fully to the welding of widely dissimilar metals, and that so little has been said with regard to welding iron and steel. Welding these metals offered exceptional difficulties, but investigations in this connection are, however, almost completed, and we hope to publish the resulting information in the near future. This difficult problem has now been solved, and ferrous metals of widely different section and composition can be directly welded with exceptionally good results.

Discussion.

The authors illustrated their paper with a number of lantern slides and also exhibited a large number of welded articles and component parts of the welding apparatus. A complete set of portable apparatus was on view and its operation was demonstrated, the welds made in horizontal, vertical, and overhead positions being very successfully carried out; a good weld was also made under water for the first time in public.

In the course of the brief discussion that followed the reading of the paper, the co-patentees of the "Cyc-arc" system were congratulated upon having overcome the many difficulties which they had encountered in the course of their work. It was pointed out that metals of different classes could also be welded together electrically by the Thompson method, and the importance of obtaining the correct shape of the surfaces to be welded was mentioned. One speaker mentioned a demonstration of the "Cyc-arc" process he had witnessed some time ago, and testified to the strength of the welds that were made therewith. Another had hopes that a machine would be produced before long that would give even better results so far as efficiency and cost were concerned, and in reply Mr. L. J. Steele explained that they had tried to weld aluminium by their new process with moderate success; the chief fault was the lack of mechanical strength. They did not claim to be the first to weld different classes of metals, but what they did do was to weld together metals of widely different size and melting points. The "Cyc-arc" system had, of course, its limitations like any other method, and he preferred not to give definite cost figures at the moment, but hoped to do so later. With regard to the polarity, they preferred to make the stud to be welded positive, as a better weld resulted, but they could weld with either polarity, and that was one of the reasons why they anticipated that the use of a.c. would be attended with equally gratifying results as d.c.

LEGAL.

Tryad Co., Ltd., v. Franco Electrical Co., Ltd.

By this action, concluded by Mr. Justice Coleridge in the King's Bench Division on December 1st, the plaintiffs claimed damages against the defendant company for failure to deliver a certain model which plaintiffs had ordered in July, 1920.

Mr. Barrington Ward, K.C., appearing for the plaintiffs, said that the chief question to be tried would be as to what damage the plaintiff company had sustained by reason of the defendants' failure. The matter started in the early part of 1920. The plaintiffs, who were advertising agents, were the inventors of an ingenious device, electrically operated, which showed the name of the person they wished to advertise. They had a model made with which they were not quite satisfied, and a friend introduced them to a director of the defendant company named Brackensey. They took with them the model and told Mr. Brackensey that they were not satisfied with it, and told him what they wanted. They said they wanted a model properly made, the details of which they gave, and Mr. Brackensey was asked whether his company could undertake the work. Mr. Brackensey assured them that there would be no difficulty in doing it. The question then was as to the time in which the model could be made. The plaintiffs pointed out that dispatch was vital to them, and they were assured that there would be no difficulty about that. Mr. Brackensey said that they would require the model in six weeks, and it was agreed that it should be made within that time, but it was not delivered in time.

The defence was that no time at all was mentioned, and it was left to the defendants to do their best and produce the model as soon as they possibly could.

His Lordship, after hearing evidence on both sides, in the course of his judgment, said he was satisfied that time was mentioned, but he doubted very much whether anything more was done than to mention six weeks in a letter. In that letter plaintiff said "we understand that the model should be ready within six weeks from this date (July 15th), but plaintiffs' original story was that it was to be within six weeks from July 8th. That showed plaintiffs' views were capable of alteration. His Lordship did not think there was a binding contract to deliver within six weeks, and the question remained as to delivery within reasonable time. From the evidence it appeared that a period of from eight to nine weeks would seem to be a reasonable time. The plaintiffs were going to exhibit the model at an exhibition to be held at the White City, and the defendants promised that it should be ready in time to do that. The plaintiffs then issued circulars and engaged a stall at the exhibition at the White City, which lasted from November 29th until December 3rd. They hoped for good financial results as the result of the exhibition of their model at the White City. It was a device for lighting shop windows. It was portable, small, adjustable, and not inflammable, and would work in such a way as would attract the attention of the public to such windows. Defendants, it seemed, put out the making of the model to sub-contractors. When the exhibition came along the model was delivered. There was only an alternating current at the White City, and when the model came to be placed in position it was found that the alternating current was useless for the working of the model. Defendants then suggested that a motor engine should be used somewhere where the public would not see it, saying it would give the public the impression that the model was being operated by electricity. Plaintiffs, however, and quite rightly too, said his Lordship, would not agree to that. The consequence was that the exhibition went by without the plaintiffs getting the buyers they anticipated. His Lordship said he was of opinion that defendants did not supply within a reasonable time. As to damages, that was a more perplexing part of the story, but on the whole he had come to the conclusion that plaintiffs might have sold 50 at a profit of £5 each. He therefore gave judgment for the plaintiffs for £250, with costs.

Father and Son in Business.

In the Mayor's and City of London Court, last week, before His Honour Judge Atherley-Jones, K.C., Mr. Charles Brannan, receiver of D. Rose (Machine Supplies) Co., Ltd., 9 & 10, Cheapside, claimed £14 0s. 6d. against Mr. Lewis, 247, Mile End Road, for electrical fittings supplied. Mr. Harry Strouts appeared for the plaintiff, and said that the plaintiff company carried on business for the sale of sewing machines and electrical goods. Two or three years ago they sold a sewing machine to the defendant, for which he paid. He was then carrying on business at Church Lane, Whitechapel. The man now appearing as the defendant was the father of the man who was really sued, and who was an electrical engineer. Lewis, junior, ordered the electrical goods now sued for, and took them away and used them in his business. He had promised payment. Now the father came to the Court, but he was not the defendant. The son had been supplied with previous lots of electrical engineering goods, and the father must have known the summons was for the son. Lewis (Senior) said that the case was a very peculiar one. The summons was thrown into his shop, and before he could explain that he was not his son the man ran out of the shop. He protested about being summoned. His name was Harry Lewis and his son's was Aaron. Two of his sons were in the electric lighting business. His son Aaron was not quite 21 years of age. He was not financing his son. The case was adjourned for a month for the son to be added as a co-defendant, and the costs were reserved.

Arc Welding Electrodes.

In the matter of letters patent No. 142,934, granted to E. H. Jones and Alloy Welding Processes, Ltd., a motion was heard in the Chancery Division on November 29th by Mr. Justice Sargant by which a rectification of the specification by amendments relating to certain wiring, &c., was sought.

The Hon. R. Stafford Cripps, appearing in support of the motion, said that the rectification proposed simply related to the striking out of certain paragraphs, and the other side (for whom Mr. F. Hunter Gray appeared) thought it a proper amendment to be made. The patent was for improvements relating to the manufacture of electrodes for depositing metals by the electric arc which are composed of metal wire or rod covered with a slag-forming material. None of the amendments, if allowed, would make the invention substantially different, as they were by way of explanation only.

His Lordship: You can take your order with leave to apply.

Workmen's Compensation Case.

At West Hartlepool County Court on the 2nd inst., the Judge agreed to an award of £100 by consent in connection with the application of Augustus E. DeQuincy, of South Road, for compensation from the Mayor and Corporation of West Hartlepool. It was stated that applicant was employed at the electricity works in Burn Road last January, when he received injuries in consequence of an electric shock. He was given light work about March, and received full wages.

Postmaster-General v. Mayor and Corporation of Liverpool.

In the Divisional Court of the King's Bench judgment was given in favour of the Postmaster-General. Leave to appeal was granted to the respondents in view of the public importance of the case.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SKELTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

30,654. "Device for grinding commutators." W. R. Cooper. November 17th.

30,670. "Electric heating apparatus." R. Bergeon. November 17th. (France, November 25th, 1920.)

30,695. "Self-producing motive power for generating electricity." J. T. North. November 17th.

30,692. "Four-way foot-control switch for electric motors for dentistry, &c." W. Gee. November 17th.

30,702. "Electric gas-lighter." J. R. Quain. November 17th.

30,704. "Electric adaptors and wall sockets." H. Weld-Blundell. November 17th.

30,725. "Electric ceiling roses." A. B. Goldsmith. November 17th.

30,730. "Devices for causing electricity to be supplied to instruments or circuits." A. R. Angus. November 17th.

30,740. "Electric heaters." A. H. Darker & J. Stone & Co., Ltd. November 17th.

30,751. "Electric heating apparatus of the thermo-siphon type." E. Albano and C. De Mattei. November 17th. (Italy, May 10th.)

30,752. "High-voltage slot-windings of electrical machines, and process for manufacture thereof." Akt.-Ges. Brown, Boveri et Cie. November 17th (Switzerland, December 16th, 1920.)

30,757. "Telephone systems." Siemens & Halske Akt.-Ges. November 17th. (Germany, November 23rd, 1920.)

30,759. "Telephone systems." Relay Automatic Telephone Co., Ltd. (Compagnie Général de Télégraphie et de Téléphonie sans Fils). November 17th.

30,783. "Electric connectors." J. H. Brown & E. Scott. November 18th.

30,801. "Supporting-means for electric sound-producing horns." Clear-Hooters, Ltd. November 18th.

30,843. "Transformer for wireless telegraphy." U. Beaton. November 18th.

30,850. "Printing telegraphy." Western Electric Co., Ltd. (Western Electric Co., Inc.). November 18th.

30,852. "Electro-metallurgy or electro-deposition of metals." A. Waldberg. November 18th.

30,860. "Self-supporting electric coils." W. W. Burnham. November 18th.

30,861. "Induction coils." W. W. Burnham. November 18th.

30,877. "Telephones." Siemens & Halske Akt.-Ges. November 18th. (Germany, December 29th, 1920.)

30,879. "Apparatus for transforming alternating into direct current and vice-versa." A. C. Norman. November 18th.

30,885. "Electric instruments." British Thomson-Houston Co., Ltd. (General Electric Co.). November 18th.

30,907. "Duplex, &c., telegraphic systems." H. W. Sullivan. November 19th.

30,930. "Electrically-heated smoothing-irons, kettles, &c." C. A. Schierwater. November 19th.

30,935. "Electric incandescent lamp holders." R. L. Aspden. November 19th.

30,965. "Utilisation of X-rays." H. J. Monson. November 19th.

30,968. "Electric heaters." British Thomson-Houston Co., Ltd. (General Electric Co.). November 19th.

30,972. "Ignition and lighting set for motor vehicles." H. G. C. Fairweather (Soc. G. Doue, O. Durand et Cie.). November 19th.

30,973. "Protecting device for electric installations." E. C. R. Marks. (S. A. A. E. Soc. Anon.). November 19th.

30,983. "Electric bells, gongs, &c." C. G. Lawson. November 19th.

30,984. "Electrically-operated horns." M. F. L. A. Aymard. November 19th.

30,993. "Electrical recording and reproduction of sound." S. G. Brown. November 19th.

30,994. "Method of multiplication of phases of an alternating current network." E. C. R. Marks (S.A.A.E. Soc. Anon). November 19th.

31,006. "Portable electric lamps." C. Hyland. November 21st.

31,014. "Electric transmitters." B. A. Pilkington. November 21st.

31,021. "Insulated connector for electric conductors." H. V. Owen, F. G. Quance, and M. J. Railing. November 21st.

31,027. "Electromagnetic apparatus for recording sound." A. F. Sykes. November 21st.

31,033. "Electric storage battery containers." G. Fuller and Fuller's United Electric Works, Ltd. November 21st.

31,043. "Electric ignition timers or distributors for internal-combustion engines." V. Shearer. November 21st.

31,057. "Electrodes or anodes for prevention of corrosion, &c., in steam boilers, condensers, &c." V. H. Cruickshank. November 21st.

31,069. "Electric excess voltage cut-out." F. Muller. November 21st.

31,080. "Instruments for measuring or indicating wattless component of alternating currents." Chamberlain & Hookham, Ltd., and S. James. November 21st.

31,083. "Electric heat radiators." A. J. Ellis and J. C. Vines. November 21st.

31,095. "Telephone instruments." Automatic Telephone Manufacturing Co., Ltd. November 21st. (United States, December 7th, 1920.)

31,096. "Apparatus for overcoming effects produced upon telegraph, &c., lines by vicinity of single phase currents." F. Carles. November 21st. (France, March 4th.)

31,121. "Mounting armatures of electrical machines." Forges et Ateliers de Constructions Electriques de Jeumont. November 22nd. (France, November 23rd, 1920.)

31,122. "Commutation of direct-current machines." Forges et Ateliers de Constructions Electriques de Jeumont. November 22nd. (France, November 23rd, 1920.)

31,147. "Terminal ends for electric wires and cables." L. F. Summers. November 22nd.

31,160. "Electric cookers and radiators." I. S. Dalgleish and E. Schattner. November 22nd.

31,225. "Electric instruments." British Thomson-Houston Co., Ltd. (General Electric Co.). November 22nd.

31,229. "Automatic electric switches." R. P. Myers. November 22nd.

31,249. "Electric switches." Western Electric Co., Ltd. November 22nd. (United States, November 26th, 1920.)

31,252. "Electric starters for internal-combustion engines." R. Haddan (F. Neumeyer Akt. Ges.). November 22nd.

31,270. "Apparatus for electrical etching." Week's Photo Engraving Co. Inc. November 22nd. (United States, April 2nd.)

31,271. "Liquid cooled electric machines." M. Seidner. November 22nd. (Germany, December 29th, 1917.)

31,274. "Electrical switching devices for sound-warning signals." J. F. Monnot. November 22nd.

31,275. "Electrical etching." Week's Photo Engraving Co. Inc. November 22nd. (United States, April 25th.)

31,312. "Electric horns of motor vehicles." W. Turton. November 23rd.

31,325. "Electric fuses or cut-outs." J. Schull. November 23rd.

31,332. "Liquid rheostats." C. C. Garrard and A. H. Railing. November 23rd.

31,353. "Production of unidirectional electric currents from alternating currents." N. Lea and Radio Communication Co., Ltd. November 23rd.

31,354. "Generating and detecting sound waves in water." W. F. Rawlinson and J. Anderson. November 23rd.

31,355. "Generating and detecting sound waves in water." W. F. Rawlinson and J. Anderson. November 23rd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1920.

13,106. "Electrically-operated cranes, hoists, and the like." W. H. Scott and J. Bentley. May 12th, 1920. (Addition to 164,784.) (171,123.)

15,731. "Telephonic call systems." R. C. M. Hastings. June 10th, 1920. (171,129.)

18,973. "Electric conduit boxes." M. J. Railing and T. Taylor. July 2nd, 1920. (171,133.)

18,657. "Wireless signalling apparatus." Radio Corporation of America. April 2nd, 1915. (146,535.)

18,940. "Method of and apparatus for receiving radio-signals." J. L. Hogan, jun. November 27th, 1916. (146,997.)

18,978. "Electric systems for the transmission of power, and multi-speed induction motors suitable for use therein." British Thomson-Houston Co., Ltd. May 31st, 1917. (147,029.)

19,183. "Sparking plugs." H. R. Bellinger. July 7th, 1920. (171,137.)

19,762. "Telephone and the like systems." M. Latour. June 25th, 1915. (147,759.)

19,821. "Electric current controlling devices." V. G. Apple. January 17th 1919. (147,793.)

19,905. "Cascade high-frequency amplifiers." Ges. fur Drahtlose Telegraphie. July 22nd, 1918. (147,853.)

20,228. "Manufacture and operation of vacuum tubes." Dr. E. F. Huth Ges. March 20th, 1918. (148,314.)

20,232. "Reels and the like for winding and unwinding aerial conductors." Dr. E. F. Huth Ges. January 10th, 1918. (148,318.)

20,401. "Generation of high-frequency currents." Ges. fur Drahtlose Telegraphie. January 19th, 1915. (148,446.)

20,441. "Electric heaters and the like." Majestic Electric Development Co. December 20th, 1917. (148,491.)

20,506. "Slip pieces for bow collectors for electric vehicles." H. Silbermann. September 1st, 1915. (148,529.)

20,832. "Sending device for subaqueous sound signals." Signal Ges. February 0th, 1915. (148,972.)

20,846. "Signal transmitting devices." Signal Ges. September 25th, 1917. (148,974.)

20,836. "Electromagnetic sound producers and receivers." Signal Ges. August 14th, 1918. (148,976.)

20,837. "Device for adjusting the degree of coupling in sound receiving apparatus." Signal Ges. August 16th, 1918. (148,977.)

20,846. "Signal transmitting devices." Signal Ges. September 25th, 1917. (Addition to 148,974.) (148,980.)

22,484. "Automatic electrical chain welding machine." Firm of "Union." September 2nd, 1919. (150,990.)

22,692. "Magneto-electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. August 3rd, 1920. (171,145.)

23,115. "Manufacture of electric rotating machines." T. Tanaka. July 11th, 1919. (152,004.)

23,201. "Process of and apparatus for electrically-treating foods and like products." F. S. Smith. August 6th, 1920. (171,157.)

23,259. "Submarine and other electrical cables." H. W. Sullivan. August 7th, 1920. Cognate application 14,079/21. (171,161.)

23,267. "Electrical connecting and supporting devices." Electric Outlet Co. Inc. January 10th, 1920. (157,063.)

23,540. "Systems of electric ship propulsion." British Thomson-Houston Co., Ltd., and J. Martin. August 11th, 1920. (171,180.)

23,565. "Transmitting and receiving circuits for wireless telegraphy." A. K. Macrorie and H. Morris Airey. August 11th, 1920. (171,183.)

23,798. "Dynamo electric machines." Soc. Anon. Pour l'Exploitation des Procédés M. Leblanc-Vickers. September 18th, 1920. (151,256.)

23,938. "Electric motors." Hoover Suction Sweeper Co., Ltd. (H. E. Hoover). August 17th, 1920. (171,194.)

24,054. "Repeaters for multiplex signalling systems." Western Electric Co., Ltd. October 31st, 1919. (153,563.)

24,297. "Link connecting piece, especially for electroliers." H. Hubener. February 11th, 1920. (158,859.)

24,331. "Electric furnaces for obtaining high temperatures." Automatic Telephone Manufacturing Co., Ltd., and P. N. Roseby. August 21st, 1920. (171,207.)

24,506. "Fault indicator for use in connection with electric ignition systems." F. A. A. Ellmore. August 24th, 1920. (171,214.)

24,632. "Electric fires." W. H. Sturge. August 25th, 1920. (171,216.)

24,774. "Means for regulating alternating-current circuits." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). August 26th, 1920. (171,218.)

24,775. "Electric arc lamps." H. H. Thompson. March 20th, 1918. (150,354.)

25,026. "Magneto electric ignition apparatus." R. Bosch Akt. Ges. August 30th, 1919. (151,003.)

25,241. "Current regulators for incandescent lamps and other translating devices." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). September 1st, 1920. (171,231.)

25,907. "Permutation locking device for controlling switches or lock bolts." A. Houston and H. P. Stephenson. September 8th, 1920. (171,235.)

26,396. "Junction boxes for electric cables as used chiefly in collieries." Greengate & Irwell Rubber Co., Ltd., and R. Povey. September 15th, 1920. (171,250.)

26,447. "Electric transformers and like apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). September 15th, 1920. (171,251.)

26,729. "Apparatus for the automatic regulation of the ignition in internal-combustion engines." Schneider et Cie. July 10th, 1920. (166,504.)

27,112. "Systems of electrical distribution." British Thomson-Houston Co Ltd. (General Electric Co.). September 23rd, 1920. (171,263.)

28,249. "Sparking plugs." F. W. Schroeder. October 5th, 1920. (171,279.)

28,452. "Means for receiving wireless signals." Ges. fur Drahtlose Telegraphie. October 8th, 1919. (152,086.)

28,582. "Furnaces." H. Fuller, R. A. Bedford, and C. Roberts. October 8th, 1920. (Addition to 141,403.) (171,284.)

28,731. "Magneto pocket lamp." A. A. Lion. October 11th, 1920. (171,285.)

29,312. "Process for fastening the electrodes in vacuum tubes, more especially in Röntgen tubes." Elektrische Gluhlampenfabrik. "Watt" Akt. Ges. October 18th, 1919. (152,617.)

29,931. "Transmission of high-frequency oscillations over high-power conductors for high-frequency telegraphy and telephony." Ges. fur Drahtlose Telegraphie. December 1st, 1919. (154,884.)

30,148. "Luminous electric discharge tubes for the production of illuminated signs and the like." M. Schmierer. October 25th, 1919. (153,004.)

34,019. "Sparking plugs." H. Burton. December 2nd, 1920. (171,313.)

34,895. "Terminals for high-tension electric cable." A. J. H. Elverson. December 10th, 1920. (171,317.)

1921.

939. "Electric gas lamps with glow discharge." J. Goosmann. January 8th, 1920. (157,095.)

4,720. "Industrial process of and apparatus for the internal electro-plating of insulators." Soc. Materiale Elettro Traazione. February 12th, 1920. (158,909.)

9,303. "Wave and current motors." E. Bouchaud Praceiq. March 26th, 1920. (160,803.)

15,062. "Electro-magnetic wave signalling systems." M. Latour. December 8th, 1915. (Addition to 147,462. Divided application on 147,462.) (164,009.)

17,240. "Mercury vapour pumps for high vacua." Akt. Ges. Brown, Boveri et Cie. July 17th, 1920. (Addition to 165,400.) (166,521.)